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ELECTRIC COOKING AND HEATING.

Now that the days are lengthening and the slack season (for electricity works) is approaching—even though it be far off as yet—it may be opportune for us to ask ourselves whether we are doing all that can and ought to be done to develop those outlets for electrical energy which help to fill up the valleys in the day-load curve, and to level up to the "peak" which has so long played the part of the old-man-of-the-sea to the electricity supply industry. As regards the use of electricity for motive power, such splendid progress has been made in this direction during the last five years or so that we need not dwell upon its possibilities. The pre-eminent advantages of the electric drive have compelled the popular world to accept it as unquestionably the most satisfactory and economical motive agency available, and it advertises itself. But in many districts there is very little existing demand for motive power, and until the manifold uses of the electric motor in the domestic *ménage* have been brought home to the housekeeper, who is usually a most conservative person, there is little prospect of awakening such a demand.

On the other hand, the demand for cooking and heating is universal, and all that is required is to divert the trade from coal and gas to electricity, not to create a new want as in the case of domestic power. To attain this most desirable object, two main conditions must be satisfied: the apparatus must be brought within the reach of the middle-class purse; and the supply of energy must be given at a low rate—certainly not above 1d. per unit. How far have these requirements been fulfilled?

Taking the latter first, excellent progress has been made; the penny unit (for cooking and heating) has already been widely adopted, and the process of reducing the price to that figure is in full swing all over the country. At least one manager, courageous beyond his fellows, has even reduced it to a halfpenny! We think, therefore, that this condition is in a fair way to be met. But as regards the former, we are by no means satisfied with what is being done. The prices of electrical cooking apparatus, in particular, are still far beyond what they should be—and, we make bold to say, what they *could* be. Until they are brought down to a level comparable with those of gas cooking apparatus, and until, like the latter, the electric cookers are made available to the ordinary consumer on hire terms, there is little prospect of any important addition accruing to the load curve from this source.

Yet, from the number of manufacturers of electric cooking apparatus in the field, and the variety of the devices which they list, it is perfectly clear that there is a large, growing and profitable market for their products. Are we not justified in suggesting that they are skimming the cream, and selling only to the well-to-do, on the principle of small production but large profits? Why do not the supply works managers bring pressure to bear upon the manufacturers, to induce the latter to cater not merely for the

rich, but also for the middle class? Until the latter is tapped, the station engineer will not make much out of the cooking business, and it is for him to see to it that a remedy is found for what, in our opinion, is a rather short-sighted policy on the part of the makers.

We should like to see a drastic reduction in the price of electric cookers; the output of these would then increase so rapidly that the lessened cost of manufacture would enable the makers to reap a rich reward, while the supply works would be greatly benefited also, and the cost of electricity for all purposes would come down still further.

Electric Cooking.

In our "Correspondence" columns, Mr. G. C. Allingham raises the question whether the shrinkage of meat cooked in an oven is detrimental to its nutritive qualities, seeing that nothing but water is lost. No one, we think, has ever suggested that the wastage represents the disappearance of solid meat; such matter is neither soluble nor volatile, and we have always understood that the loss in weight must be due almost wholly to evaporation. We should be very much surprised to find that any other view was held or advocated.

We are not in agreement, however, with our correspondent in his suggestion that, as the meat is obtained in a more concentrated condition when well shrunk, a correspondingly smaller quantity of it should satisfy the appetite. We are digressing into a highly contentious field, we know, as illustrated by numerous proverbial sayings; but we believe it will be admitted that the appetite is satisfied only by volume, and takes no account of the percentage of nutritive matter in the food consumed. Most people eat too much rather than too little, and therefore the lower concentration of the nutriment would not hurt them, even were the conditions of assimilation the same; but they are not. The fact that meat cooked in an electric oven retains more moisture, and is correspondingly juicy and succulent, is not only gratifying to the palate, but also ensures that the food is much more readily digested, and a greater proportion is assimilated than when it is dried up and toughened by faulty methods of cooking. Thus, while (as pointed out in our last issue) the butcher's bill is greatly reduced, the consumer is benefited by the improvement in the quality of his food. It would be an excellent thing if some independent authority would undertake a thorough scientific investigation into the whole question.

The Association o Consulting Engineers.

The inaugural meeting of those interested in this *proposed* Association was held at 4 p.m. on Monday, but we are at a loss to know why it was called a public meeting, for the Press was excluded. True, when we were turned away, we were promised an official report of the proceedings, but at the time of going to press with these notes, it is Wednesday night, and nothing has come to hand. Mr. Swinburne was in the chair, and he was supported by Messrs. Hammond, Patchell, Handcock, Dykes, Snell, Taylor, and others of the self-elected committee of senior and junior men who have set themselves up to say what engineers shall or shall not practise their profession free of molestation, for to this, so far, the affair has got, and it promises to go further.

To begin with, though the printed rules no longer contain the obligation of being a member of the "Civils," this unfair obligation has been, or is going to be, put back. It suits the self-appointed. The Association is going back on its amended resolution, and proposes to narrow its boundaries, in response to the agitation of those who evidently want to make the organisation as limited and exclusive as they can. The rules, however, will admit of special condescension being meted out to non-Civil consultants if the Council regard them as "fit."

A courteous letter received from the Institution of Civil Engineers relating to the Association could not be read, as it was found to be marked "confidential." We believe, however, that, in brief, it gave the promoters very little encouragement, and, from what we can learn from an observation passed by the chairman, it did not admit that such an Association was necessary.

The self-elect ensconced behind the barrier are to sit in judgment on their fellows. No matter that a man may have entered the profession by the old and time-honoured method of pupilage; no matter that he may have been 20, or even 40, years in practice, he is to be subject to this self-elected body, some of whom may never have been engineers at all, or may have entered by flaws in the fence, and some, who have fairly and squarely entered, were in their cradles or at school when years of strenuous work had begun to bleach the heads of those they assume to judge. To our minds the whole thing is ludicrous. The rules of conduct are all very well; but can all the proposers of them lay their hands to their hearts and say, "All these things have we observed from our youth up"? We fancy not, and one of the speakers in the body of the hall seemed to think so, too, for he twitted the Committee with being now easily able to keep these rules, as perhaps the flow of business obviated the need to-day of their breaking them. General dissent seemed to hang round the proposal to shut out all but "Civils." An Association can do as it pleases as regards its membership; but when this Association is stronger it means to try for an Act of Parliament to compel all public bodies to employ only these "Unionists!" We have all been sorry to see Lancashire operatives lately condemning to unemployment non-unionists, fully their equals; but this absurd proposal of the A.C.E. out-Herods Herod in this respect.

Certain speakers spoke of the mean practices employed by certain engineers in touting for work where already consultants had been called in. If the A.C.E. would widen its base and do what it could to preserve honest practices, we would gladly welcome it, but nothing transpired at the meeting which led one to expect any great attempts in this way. The object to be attained is so far, only too obviously, advertisement, but advertisement which will be all to the benefit of the self-elect and their friends. Everyone knows that requests to presidents to name men for certain work have been abused. The new Association, by its methods, is to secure this sort of patronage, and where will the wheat be allotted and where the mere chaff?

A grave injustice is being attempted upon men who are outside the Civils, men who would snap their fingers at any attempt to coerce them, yet who would join the A.C.E. if it were fair dealing. If, as the chairman said, clean practice is a chief aim of the Association, let it stick to this, and avoid all advertisement.

This meeting cannot be said to have given confidence to anybody; and notwithstanding the vote of confidence in the committee that for some reason or other it was thought necessary to pass—though there were some against, some neutrals, and some who had criticised had left the meeting before the vote was taken—we imagine that the moving spirits are hanging their heads. However, we will not anticipate—we will wait and see.

Railway Electrification.

The electrification of main-line railways is a topic which every day is bringing more closely to realisation. What it means to the electrical industry of this country can hardly be measured. It would be a misfortune should the early work fall into the hands of foreign firms who would carry out the work on different systems, thus bringing about a worse confusion than the confusion of gauges many years ago. The time appears to be ripe for a preliminary conference of railway men, who might discuss first the general principles which should guide the railways in their choice of a system, much on the same lines as the Continental authorities have dealt with this matter. Uniformity of system throughout the country is essential. Already we find men advocating a double system, one for suburban traffic and another for main-line work. This may be wise; we would not hastily condemn it, though on the face of it, it appears to be fraught with very serious consequences in the future. So far as the main-line work is concerned, it can-

not be regarded otherwise than as essential that an agreement should be come to between all the railways to follow the same system, so that in every main detail absolute interchange of vehicles should be possible. Except in the matter of brakes this is practically the case with the steam roads to-day, but the one item of brakes has led to a difference of practice that has been of very considerable inconvenience, and should afford a lesson to the men of to-day. Our railway men generally have not in the past acted together very harmoniously. In America, where vehicles may break down very far from home, there has been a serious effort to standardise cars, so that repairs can be made by foreign lines, and vehicles kept in service and rendered fit to be run home on their own wheels. A moment's thought will convince anyone of the difficulties into which railway working would be thrown by a break of system from overhead to third-rail or from single-phase to D.C. Already the directorate of one short main-line railway is contemplating an early change-over to electricity.

It ought at least to be agreed that no railway should change over more than a certain limited mileage until a given year. It is quite likely that all the railways which carry out the conversion of 50 or 100 miles of line will find cause to effect many changes and improvements; but neither the faults nor the successes of any change-over ought to be kept secret. Every detail should be tabled and brought to a properly comparative datum, so that all may know what each venture has proved, whether good or bad. With such facts on which to work, a Committee of engineers and managers should be able to arrive at a conclusion to which all should faithfully adhere. Commercial men have been too little disposed to work amicably together, and the interests of all have too often been sacrificed to mere personal pique. Such a spirit ought not to be allowed to jeopardise the future of electric traction on main-line railways.

Printing Proceedings.

FOLLOWING in the steps of the American Society of Mechanical Engineers, the American Society of Civil Engineers has made a slight, but very commendable, change in the arrangement of papers in copies of the *Transactions*. Every paper is commenced on an odd-numbered page, that is to say, on the right-hand page of the open book. By this means the first part of a paper can never be printed upon the same leaf as the last part of another paper, and in splitting up a volume for separate filing, or even preservation of papers, every paper can be removed without destroying the completeness of another paper. Possibly the councils of many institutions will stand aghast at the idea that any member could be so lost to a proper sense of the value of their *Proceedings*, and will scout the idea as vandalism. But everyone knows that the accumulation of *Proceedings* is a serious problem in the library of the average house. Few of the volumes are ever opened or read; the majority, if not sent out cut, are never cut. When a man dies, his accumulations of years are sold for a few pence only, and the dealer who purchases the volumes sells them to an unwary junior thirsting for literature, at a huge profit.

Everyone knows the vexation of desiring to preserve adjoining papers on different subjects and the impossibility of making up one's sets of filed cuttings. The Institution of Civil Engineers' *Proceedings* forms about the worst example, because of the range of subjects treated. With the enormous mass of *Proceedings* which are now pouring from the press, it would seem desirable that a way should be found that would lead to the issue of unbound *Proceedings*, every paper being separate. Members might even be able to have sent to them only such papers as they desired.

A very large number of the published papers of any society cease to have any but historic interest in 10 to 50 years according to the nature of the subject. In electricity particularly this applies, because practice has not become crystallised.

BRAZIL: ITS PRESENT CONDITIONS AND THE POSSIBILITIES FOR FUTURE COMMERCIAL RELATIONS WITH GREAT BRITAIN.

BY C. E. BEST AND H. L. PARROTT.

(*Concluded from Vol.* 69, *page* 990.)

Water-power in the State of S. Paulo.—We believe that in no country in the world has Nature more bountifully bestowed this latent power than in Sao Paulo State. In the River Tieté—the same as that which supplies the S. Paulo Light and Power Co.—there is another large waterfall, the "Salto de Itu," where, for a length of 150 m., there is a very rapid fall. If its full capacity were controlled, it would be sufficient to generate at least 75,000 H.P. At present it is tapped in Itu in several places, and thus supplies several sugar factories with ample motive power. The town is not of very great importance, the population being some 25,000; however, a system of electric tramways with public lighting might prove an attractive enterprise.

Lower down the same river there are several other falls, the most important being Bana Grande, Escaramuca and Avanhandava.

The Brazilian North-Western Railway has a line which reaches the last-mentioned fall.

Still further down this river, and near its junction with the Rio Grande, there are other rapids, and also the renowned cascade of Itapura, with a fall of over 44 ft.

Then in the Rio Grande is the Urubuhanga fall. The volume of water in these two last-mentioned falls is calculated to be some 7 million litres a second, which nearly equals the great Niagara. Power to the extent of more than 1,000,000 H.P. could be generated in this locality. It is well that English firms should be aware of these latent sources of power, for industry of the future must inevitably utilise them.

The Sao Paulo Tramway, Light and Power Co., Ltd.—This company was authorised to transact business in Brazil in 1899. It has acquired all the tramway lines of Sao Paulo with virtually perpetual concessions and exclusive rights to operate the tramways service in the city and suburbs for a term of 40 years from 1901, and has also the concession for the supplying of electrical energy, which is practically perpetual.

The company has now some 100 miles of track in operation, and is still extending its lines, not only in the city, but also out to various suburbs. There are also some 150 nine-bench standard-gauge open cars running, which gives Sao Paulo, with a population of 350,000, a car service that can be favourably compared with any city of its size in the world.

The electric energy is generated near the village of Parnahyba, on the River Tieté, some 35 km. distant from Sao Paulo. Here are installed eight turbines and generators, with a capacity of some 32,000 H.P. The current is received from the generators at a pressure of 2,300 volts, which is transformed to 40,000 volts, then sent over a four-circuit transmission line to the distributing station in Sao Paulo, where it is again transformed to 2,200 volts for distribution throughout the city for general use.

The city of S. Paulo is situated in the valley of the River Tieté, 2,500 ft. above level of the sea, and 35 miles from Santos, the seaport of the State.

Owing to the natural resources of the State, and the advantageous position of the city, Sao Paulo is now the third most important city of South America, being only surpassed in commercial movement and population by Buenos Ayres and Rio de Janeiro.

It is an industrial centre for the manufacture of cotton goods, which of late has developed to a very large extent, and therefore greatly diminished the importation of such goods from Manchester. It tends to become self-supporting in the supply of the home demand, which the Government has conscientiously assisted by the imposition of a very high Customs tariff.

Then, again, there is an enormous industry of the bag and

sack manufacture. There is a big local demand for sacks, especially for the coffee, of which there is an average export of some 12 million sacks. Rice and sugar also use up a big quantity of bags, while flour is another big item. Nearly all the supply is furnished locally.

The big factories have taken advantage of electric power, and now most of them have supplanted the old style of motive power by electricity. This is an example of what is taking and must take place in most of the important towns of Brazil. The national policy is that Brazil should become self-supporting as far as possible in all branches of industry.

Rio de Janeiro.—As most of our readers probably know, the Central Railway of Brazil, one of the most important in the country, is under direct control of the Federal Government.

Its main route connects Rio with Sao Paulo, a journey of some 250 miles. Besides this, there is a good local service connecting the various suburbs with the Federal capital of Rio. It is to this service that we would call our readers' attention. Last year the Government decided to electrify this system, which comprises some hundred miles of lines. But we understand that the Congress has not yet passed the credit to pay for this big change, so no contract to do the work can yet have been accepted.

It seems probable that the electric power will be furnished by one of the companies already established there, who are the Rio Tramway, Light and Power and Messrs. Guinle and Co.; the latter are a very important Brazilian firm, who, by their brilliant enterprise and energy, have obtained some excellent concessions during the last few years.

However, it is in the furnishing of all the necessary material for electrifying the lines that we think English firms should interest themselves. In this respect it is at once evident that it will not be sufficient or advisable to rely upon information obtained either from journals or the British Consul. It is absolutely necessary that big firms should have their own representatives resident in the country, as only by this means can they be kept informed of the continual improvements and developments under project.

Bahia.—Going further north, the first seaport town of importance we reach is Bahia, a port at which nearly all the mail steamers call. The completion of the port works at present in operation will bring general improvement, not only to the welfare of the State, but also to shipping interests. At present the big trans-Atlantic steamers anchor some considerable distance away from the quays, the cargo having, therefore, to be transported in lighters, while the passengers are conveyed to and from the shore in rowing boats.

The town has a very good service of electric tramcars, this being in the hands of the same company, which controls the trams and lighting of the Capital, Rio de Janeiro.

The lighting of the town still needs much improvement, but this will, no doubt, be effected in the near future.

The railways of the State of Bahia have all been taken over by a French Syndicate, who paid the late owners a large sum as compensation. The railways are in a very bad condition, both as regards permanent way and rolling stock, but they are to be greatly improved and extended, as the prospects for new developments are very encouraging.

The city of Bahia was the first Federal Capital of Brazil, but in the latter part of the eighteenth century the great natural advantages of Rio deprived it of this honour.

The city is built on a big incline, and is divided into two parts, the district of the higher locality being called the "Upper" town, which is the residential part, and is reserved almost exclusively for private dwelling-houses, hotels, and the Governor's Palace, &c. The "Lower" town comprises the commercial centre. Access to the Upper town is by means of electric lifts. Both sections of the city have a good telephone service.

Products.—The chief products of the State are:—Tobacco, cocoa, sugar, hides, coffee, cotton, and manganese ore, the first two mentioned being the most important.

Proceeding Northward we come to the seaport town of *Maceio*, Capital of the State of Alagoas, with a population of some 40,000 people. No passenger steamers call at this port, but it is of considerable commercial importance. Electric light is already used here, but acetylene gas is used to a large extent in the dwelling-houses.

The tramways are at present mule-drawn, and are, therefore, in sad need of reform. There seems to be every facility at hand for generating electric power, and encouragement is offered to firms who entertain the project.

The town offers various employment to engineering interests. The telephone service is far from satisfactory, while the drainage of the town needs thoroughly reforming. The harbour also lacks facilities for shipping purposes, but we are given to understand that a Government Commission of engineers has studied the locality, and its report and proposed improvements are under consideration.

Pernambuco.—Going further north we come to Pernambuco. This is a town and port of first importance, as it is the first port at which mail and passenger steamers call from Europe. It is protected by a coral reef which runs parallel to the coast for some miles. Port and harbour construction works are proceeding favourably, and their completion will greatly increase the natural progress of the town and State.

It is upon the coral reef that the new quays are being constructed, and when they are finished the inner channel will be dredged. This will permit any steamer to enter the port and discharge alongside the wharfs.

At present big steamers, such as those of the Royal Mail type, are forced to anchor outside the coral reef, and discharge passengers and cargo in similar manner to that at present in vogue in Bahia. The extra expense thus entailed must tend to retard normal development.

The town of Pernambuco is rather compact, though some of its suburbs are situated a considerable distance away, as Olinda, for instance, which was at one time the Capital of the State. It is now the chief residential suburb. There are several important suburbs, which are suffering under a poor service of the "Street Railway" to connect them to the city.

For want of more modern and satisfactory means of transit, the cars of the "Street Railway" are well patronised, in spite of the black smuts and dirty smoke, which are blown into the passengers' faces.

Although one may travel in greater comfort by tramcar, it takes much longer, as the trams are drawn by mules. Probably no other town of importance in Brazil is burdened with such an unsatisfactory service of road-car. However, a new political party has lately been elected to govern the State, so we are confident that many drastic and much-needed reforms will now be carried into effect.

This appears to us to be a most opportune time for British firms to take active interest in the country, if they wish to take a share in the many big engineering works which will undoubtedly be put into operation in the near future.

There are some 35 miles of tramway lines served under the present concession, but if the whole system were to be electrified, it might easily be extended to 80 or even 100 miles of profitable tramway. The present concession holds good for a further period of nine years, but this in no way prohibits firms from procuring a concession to electrify and extend the service later on.

The lighting of the town and private houses is by gas, and very poor at that. The municipality has the street lamps extinguished on moonlight nights, which occur frequently in tropical countries, such as Brazil. It seems probable that a concession might be granted to furnish public lighting as well as run a service of electric trams.

The telephone system and service here are also much in need of reform and improvement. They are at present so poor that, but for absolute necessity, there would be few new subscribers.

The principal and practically only railway in the State is that of an English company—the Great Western of Brazil Railway. It is one of the most important in the whole Republic. It connects the principal towns with the Capital, and has a branch line running north to Rio Grande do Norte and another line running south to Victorio and Maceio, Besides this, there are many miles of new line under construction.

Commercially, Pernambuco is principally noted for the large quantity of sugar and cotton which she exports. Her cotton is highly appreciated both in England and in U.S.A., and is considered by many to be the finest quality that is

grown. Of sugar she produces more than any other State in Brazil, while she is the second most important tobacco producing State.

The most delicious tropical fruits grow here in great abundance, especially pineapples and mangos. As Brazil is the only country in the Southern Tropics where fruit is grown and cultivated with so little trouble, a very profitable business of preserving and exporting fruit might easily be established. Their best fruits ripen during our winter, just at the time when fresh fruit is so expensive in Europe.

We are of opinion that the tide of prosperity has turned in favour of Pernambuco, and as she is adopting a policy of liberal progress and rapid improvement, British firms may with advantage study the present conditions more closely, with a view to obtaining a share in the work of development. This also applies to many other parts of Brazil.

NOTES ON THE CHEMISTRY OF THE LEAD CELL.

BY J. HORSNELL MAY, M.I.E.E.

THE time has passed when any such simple formulæ as those of Gladstone and Tribe, Darrieus and FitzGerald, satisfy later experience with the lead storage battery. Wade, in his theory of polymeric lead sulphates, probably touched the fringe of the reactions which may and do occur. Something of the nature of the reactions indicated by him would probably take place in the lead peroxide—sulphuric acid—lead cell *per se*, but this has not yet been produced. Every cell contains materials which to a greater or less extent affect its internal changes from a chemical or electrochemical point of view, and these materials doubtless have their effect on the production or the reduction of the lead sulphates, as well as in other directions. In other words, there are always substances in a cell, the presence of which have a part in the ultimate action and reaction between the lead active material and the elementary electrolyte. These substances play an important part in the behaviour of the cell—substances which, for the want of a better name, may be termed "impurities," and which may be defined as additions to the cell which, entering into chemical or electro-chemical action, modify those changes in the cell which would take place in their absence. In this article the term "impurity" is used in this sense.

The degree and class of sulphatation (and the ease of desulphatation) are largely governed by these impurities, although it is admitted that in certain cases their presence may to some extent affect the reactions from a physical cause.

At one time it was an article of faith that stringent purity in the lead cell was essential. To-day this article of faith has become an established fact, so long as the impurities are not chosen with care. It would, however, appear also true that impurities are often beneficial.

Some time ago, a systematic agitation was started in order to prove that a minute quantity of ammonium in the electrolyte of a cell was necessarily fatal; yet it is known that far higher percentages have not been without good effect. The presence of chlorine is said to produce good results under certain conditions. Zinc added to negative paste has occasionally given beneficial results. Arsenic (in conjunction with copper) has proved, after the closest investigation, to be the salvation, in at least one case, of a portion of a battery. Iron and antimony are other impurities which have been greatly condemned—yet these have been known in particular circumstances to give beneficial effects.

In connection with all the above instances, the greatest care has been taken to eliminate the influence of disturbing factors. "What then," asks the engineer with a battery, "am I to do—shall I add ammonia, arsenic and copper to my cells in order to keep them in good condition?" The answer is an emphatic "No," coupled with sympathy for the engineer who (having heard that iron might conceivably be good under certain conditions) dropped French nails into his cells. (The thought arises that arsenic, in the form of rat poison, and properly used, might possibly be a surer and quicker end to that engineer's troubles.)

The promiscuous use of impurities is not advocated. What is wanted is a keen and prolonged examination into the effect of impurities, under all likely conditions of usage to which cells may be subject.

It has often been stated by those who should be best qualified to know, that the use of wood sheet separators increases the capacity of cells. This effect would not seem to be entirely physical, or due to modifications in circulation of the electrolyte. There is surely a chemical effect. Again, the benefit of certain "expanders" in paste (in order to prevent it from shrinkage and to keep it porous) would not seem to depend entirely on physical action. The physical condition of the paste is certainly altered (initially and afterwards), but there is probably beyond this a species of local action due to the electrochemical effects of an impurity. A full recognition of this would be the beginning of the end of the fetish of purity. Edison uses lithium in his alkaline cells, and is not ashamed to own that its action is obscure. The actions of certain impurities which may be beneficial in the lead cell are probably less obscure, although the difficulties in the way of their elucidation are many. One of these difficulties is found in the inaccuracies of chemical analysis, which often lead the patient observer astray.

Chemistry is one of the exact sciences, and it might reasonably be inferred that within fair limits, chemical analysis was an exact art. Experience, however, leads one to suppose that, in matters relating to the storage battery (and the materials used in its manufacture), there is room for very considerable improvement as far as the analyst is concerned.

The following (culled from a fuller note-book) are a few instances which show the vagaries of analysts, care having been taken to choose the results of those having repute :—

(*a*) It was desired to know the exact percentage of ferric-oxide in certain samples, this point being particularly impressed upon those making themselves responsible for the results given. The percentages certified are as below :—

	Sample 1.	*Sample* 2.	*Sample* 3.
Analyst 1...	·0188	·0331	·0034
„ 2...	·0126	·02	·0086
„ 3...	·0108	—	—

The significance of the above can be seen, when taking the writer's own figures as 100 the following table presents itself :—

	Sample 1.	*Sample* 2.	*Sample* 3.
Analyst 1...	165	155	36
„ 2...	110	93	91
„ 3...	95	—	—

Disconcerting as the above figures may prove, the further examp'es show greater discrepancies :—

(*b*) A sample of pig lead was submitted to a firm of analysts, with the result that the figures for iron and for antimony were each about 1,000 per cent. higher than the figures from another source (which had confirmation).

(*c*) A sample of pig lead was sent to a metallurgist for estimation of impurities. He reported ·22 per cent. of impurity, and on the absurdity of this being pointed out, he reconducted his analysis and gave a further report showing only ·02 per cent.

(*d*) Two samples of acid were certified as identical. These were sent respectively to two independent analysts. One found the presence of five impurities, which the other did not find, and the latter found three impurities undiscovered by the former. Only two like impurities were found by both, and of these two the quantitative estimations varied by 192 per cent. and by 500 per cent.

(*e*) Two samples of acid, known to be of the same order, were submitted to an analyst. The comparative results were absurd and contradictory. One impurity was given as ·437 per cent., instead of ·045 per cent., in one sample, while conforming to a figure previously obtained in the other.

(*f*) In a case before the High Court, which centred round a certain impurity of easy estimation, the sworn evidence as to its quantity varied by 250 per cent.

These facts and figures show one of the difficulties to be overcome before the "impurities" in a lead cell can have their action rightly determined.

NOTES FROM CANADA.

[FROM OUR SPECIAL CORRESPONDENT.]

Some forty municipalities and villages in the province of Ontario voted, on January 1st, on the question as to whether they were in favour of obtaining electric power from the Ontario Hydro-Electric Power Commission. Every place voted in favour, and in most cases the majorities were very large. As these townships are distributed over all the older parts of the province, and many of them are quite small communities, it shows the evident desire of the people of Ontario to own and utilise its water-powers for themselves. There is talk of the Commission buying out the Electric Power Co., which supplies current in a large part of Eastern Ontario, and mention of which has already been made in these Notes.

Very wide legal powers are possessed by the Commission, and, besides acting as a distributor of power, it intends to draw up and enforce rules and regulations relating to the generation, transmission, distribution and application of electrical energy throughout the province. At the request of any municipality the Commission also prepares estimates of the cost of supplying hydro-electric power, and takes measurements of stream-flow, &c., in cases where undeveloped water-power is available locally. The Commission also acts as a mediator between municipalities and private companies if desired.

One of the aims of the Commission for the near future is the supply of electrical energy to farmers for agricultural and dairy purposes, and, of course, for lighting.

If it be possible to carry out this scheme successfully, the country districts of Ontario will become much more attractive than they are at present, as the roads and streets of small villages will be comparatively well lighted, and a good deal of the drudgery of farm work will be done by machinery.

The Conservation Commission of Canada has just issued a comprehensive and extremely interesting report on the water-powers of the Dominion. The water-powers of Western Canada, although touched upon in the report, are to be dealt with more fully in a later one. The present report contains a number of very good photographs of some of the more important waterfalls, in addition to which six large maps are issued in conjunction with it. The writer hopes to give some interesting details from this report shortly.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Association of Consulting Engineers.

The attention of our client Mr. A. H. Dykes, of 11, Victoria Street, Westminster, S.W., who is the honorary secretary of the Association of Consulting Engineers, has been drawn to the leading article headed "The Association of Consulting Engineers," which appeared in the issue of your paper, the Electrical Review, for January 12th, 1912. The article contains the following statement:—"The honorary secretary himself . . . . . if we are not mistaken, is a director of a contracting company which undertakes wiring work in connection with schemes in which he is interested."

This statement is quite untrue and without any foundation whatever.

As it certainly will, if not contradicted, cause our client considerable injury in his profession, we must request you to publish this letter in your next issue, and in as prominent a position as that in which the statement complained of appeared.

Faithfull & Owen.

Westminster, *January 16th*, 1912.

[Before the above letter reached us we had been informed by Mr. Dykes that we were mistaken in the statement referred to by our correspondents, and that being so, of course, we have no hesitation in withdrawing it.—Eds. E.R.]

Capital and Labour.

As a working electrician, I was keenly interested in your open letter on Capital and Labour, and write to thank you for inserting the same. It is not to be expected that the Trade Union leaders like it, but it cheers all true workers to find that at least one paper is not afraid to support justice against the unions.

It is not often that we working men express our views in the Press, but this is not because we do not feel the tyranny of the unions quite as much as the masters.

When I use the term workers (so loved by our present-day politicians), I use it in the true sense, *i.e.*, by applying it to the men who do work, and have an interest in that work—not clock-watchers and shirkers.

I often try to find what good the unions have done the real worker. All I can find is that in most cases the same, and in some, better wages are paid to the unskilled than to the skilled worker. In skilled workers I include draughtsmen, engineers, assistants, &c.

How often does one notice vacancies advertised for the above at wages far below that of a dock labourer or a coal miner?

Trade Union leaders are fond of talking about political economy. Is it ideal economy from a political point of view to overpay a class of man whose only interests are beer, baccy and football, at the expense of the men who have first to go through years of training, and whose interests are such as to increase the better trades, for instance, such as tool-making, book-binding, &c., and who is usually keen on improving himself and his trade. I maintain that it is impossible to go on increasing the unskilled wages at the rate which has been done of late without making the skilled man's lot harder.

A real working man's politics consist only in his wanting a fair wage. The politician talks a lot, but only gives him inspectors, causes ill-feeling between his master and himself, puts up the price of production, and therefore the cost of living, and, worst of all, reduces his chance of getting a better job.

If the unions are ever to help the real worker, and draw him to their ranks, they must throw over the political section, and work for what they only pretend to do now, *i.e.*, to improve the workers' conditions, and that must be in a common-sense manner with honest men for leaders, not job grabbers.

It would not be long, under these conditions, before most of our works would be running under a co-operative system, and England's trade regaining what it has lost in the past through strikes and the fear of them.

A Conscientious Worker.

Old Carbon Ends.

A correspondent from the Straits Settlement asks for a suggestion regarding the utilisation of old arc-lamp carbon ends. Instead of consigning them to the cinder tip or mortar mill, experience has shown that they may be employed with advantage in connection with lightning conductor work. Owing to the higher conductivity of pure carbon compared with coke, the unconsumed pieces of arc-lamp carbons make an excellent bed for conductor earth plates. The resistance is low and the demand rarely exceeds the supply. About six bushels per hole is a reasonable allowance.

A more ingenious, though less practical, suggestion is that of cementing several ends together, so as to form a single long carbon. The procedure is as follows: First cut the ends of the pieces so as to allow them to fit together, then cover the ends with a paste made of water glass and powdered carbon, afterwards lightly pressing the pieces together and allowing time to dry and harden. Such made-up carbons were found to be satisfactory when a number of tests were made several years ago. They burned both with direct and alternating currents just as well as new carbons, even at the

junctions. The resistance was but little greater than that of new carbons, whilst, as regards mechanical strength, the made-up carbons, when subjected to a uniform stress, were found, if anything, more liable to break between joints than at the joints.

The exception to this rule was noticeable in the case of open type D.C. arc lamps, where the excessive rush of current at the moment of striking the arc acted disastrously upon the made-up carbons. The jointed ends became red hot, then incandescent, and immediately afterwards broke into as many parts as there were jointed sections. Experiments with enclosed lamp jointed carbons were invariably successful.

The whole of the foregoing observations have reference to solid carbons; the subject of mineralised carbons is, therefore, not dealt with.

J. H. Runnett.

Bolton, *January 15th*, 1912.

[An article on the subject by Mr. Runnett appeared in our issue of August 17th, 1906, giving more detailed information.—EDS. E.R.]

The Economy of Electric Cooking.

It has been frequently stated that meat, when roasted in an electric oven, loses only about 10 per cent. in weight, as compared with a loss of about 30 per cent. when cooked in a gas or coal heated oven. But does that mean that 30 per cent. of the actual meat disappears? Is it not almost entirely water which evaporates? Surely no appreciable amount of the nutritive substances in the meat vanishes into thin air?—a small quantity of the juices may run out of the meat, but that would only represent a very small fraction of 30 per cent. of its weight, and would, moreover, be saved.

If my supposition is correct, I fail to see where the saving of meat due to cooking by electricity comes in, for the only effect of cooking by the older methods is that the meat is obtained in a more concentrated condition, and a correspondingly smaller quantity of it should be needed to satisfy the appetite.

I am open to correction, and I hope I may be wrong, for I am a whole-hearted supporter of electricity. But if I am right, it does seem to me that the new "electric cooking" poster of the Electric Supply Publicity Committee is based on a mis-statement worthy of the *Journal of Gas Lighting*.

G. C. Allingham.

Hendon, *January 15th*, 1912.

[We refer to this matter in our leading columns.—EDS. E.R.]

LEGAL.

AVEBURY *v.* THE NATIONAL TELEPHONE CO.

IN the Chancery Division on January 11th, this action was again mentioned to Mr. Justice Joyce on an application to fix a date for the trial.

MR. YOUNGER, K.C., reminded his Lordship that the question to be determined was as to the right of the debenture stockholders to a premium on the redemption of their security under the terms of the sale of the company's undertaking to the Post Office. When the motion for an injunction came on, it was recognised that it would not benefit anybody to stop the sale, and it was agreed that £50,000, which was the amount in dispute, should be placed in joint names pending a decision of the dispute. He now asked that a convenient date early these sittings should be fixed for the trial.

His LORDSHIP: There is no hurry, except to get the money.

MR. PERCY WHEELER said that the parties were anxious to have the matter disposed of. Next Monday fortnight (January 29th), would be a convenient day.

His LORDSHIP said that the case must be mentioned again later. He could not fix a date, and it was quite possible that some other Judge would try it.

THE DAVIS ELECTRICAL CO., LTD.

MR. JUSTICE NEVILLE, sitting for the disposal of companies' winding-up business, had before him on Tuesday, January 16th, a petition by James McDougall, for an order for the compulsory winding up of the Davis Electrical Co., Ltd.

MR. JENKINS, K.C., in support of the petition, said that the respondent company was formed in 1908 to take over a business of dealers in and manufacturers of electric lamps. It was in the nature of a private company, and the nominal capital was £3,000, divided into 1,000 preference and 2,000 ordinary shares. For the sale of his business to the company, Mr. Davis received £1,998, which was satisfied as to £998 by the issue of fully-paid ordinary shares, and £1,000 was satisfied by the issue of a debenture which was a first charge on the assets of the company. Further debentures were issued by the company, which were alleged to have been issued in consideration of cash. There were two directors of the company—Mr. Davis (who was entitled to £500 a year, which £500 he received right up to the date of liquidation) and a Mr. Howlett (who was entitled to 7s. a week). The company from the commencement, said counsel, carried on business at a loss, and in fact, it was alleged that Mr. Davis was himself carrying on business at a loss when the company was formed. The petitioners were creditors for goods supplied, and it was alleged that the company went on trading right up to the time that it went into voluntary liquidation, and received goods to a considerable value, which goods were now claimed by the debenture-holders. Those debenture-holders were Mr. Davis and a Mr. Levy, who was said to be his father-in-law. The resolution for voluntary winding-up was passed on October 11th, 1911, and Mr. Corfield, an accountant, was appointed voluntary liquidator. He was also appointed receiver and manager for the debenture-holders, and although no allegation whatever was made against Mr. Corfield, the petitioners felt it was to the interest of the creditors that an independent liquidator should be appointed.

MR. YOUNGER, K.C., for the company, offered that an independent liquidator should be appointed, but objected to a compulsory winding-up on the ground of expense. The resolution for voluntary winding-up, he said, had the support of creditors to the amount of £1,884 odd, out of a total liability of £3,333. Mr. Corfield was a complete stranger to the parties until he was appointed liquidator. The principal reason urged by the petitioners for the interference of the Court, seemed to be that goods to the value of about £1,600 were obtained by the company within a few months of the voluntary liquidation, but such a contention rather savoured of hyprocisy, for the goods the petitioners had supplied during the last few months were but for a very small amount, and they were seeking to get the advantage of the larger quantity of goods supplied by the other creditors.

MR. HARMAN, for Mr. Davis, objected to a compulsory order on the ground that the voluntary liquidation was for the benefit of all the creditors.

His LORDSHIP said he thought that in a case such as this he must give effect to the wishes of the majority of the creditors, and there must be a compulsory order.

The usual order for winding up the company compulsorily was made accordingly.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to this column should be written on one side of the paper only.*]

"VEXED" writes:—"I bought certain telephones as per advertisement in your paper, 'the lot' going for £5. I had two on appro. at first, conditionally that if I did not buy I paid carriage on return. The seller, instead of sending carriage paid, sent carriage forward, and asked me to send them on to *another firm carriage forward* if I did not buy. I protested against sending them to any one but himself, as a third person might involve complications. I offered him £4 10s. for telephones *delivered*. This he refused to accept, and said he would send them if I would send cheque for five guineas, 5s. being for boxes to pack them in. I replied he was legally bound by his advertisement and by sending appro. instruments on the terms as advertisement. I said I accepted his offer, as advertisement, for £5 for telephones *delivered to me*. By this I meant *carriage paid*, and not *free on rail*. I told him I should pay for no boxes or any packing, as that had nothing whatever to do with me, as he could deliver as he liked, either by railway company, motor-car or any means, as I bought the telephones delivered to me, and they were his, and at his responsibility, till I accepted them as being equal to samples. Of course, I sent cheque with order, as he would not send goods without cash, and I deducted the carriage of goods sent on appro.

"He then sent the remaining goods carriage forward. I refused them, and they have lain on railway company's hands for some days, and I maintain they are not mine till I accept them, and free of any liability. He refuses to pay carriage.

"I think that such goods as these, when advertised, are bound to be delivered free to buyer, and they are sender's goods till accepted."

*** There is no rule of law which provides that goods bought must be sent by the seller to the buyer at the expense of the seller. It is difficult to see how any such undertaking on the part of the seller is to be inferred from the contract; and there is no form of action by which the expense of sending or packing could be recovered from the buyer. When the goods "on appro." arrived carriage forward, the buyer then had the option of refusing to accept on the ground that he wanted to take delivery at the seller's place of business; but if (as is most likely) he asked for two to be

sent "on appro.," it seems that the seller was entitled to send them "carriage forward." "Vexed" might now, in asserting his full legal rights, say that the contract was to take delivery at the seller's place of business, and claim delivery there; but then he will only have the expense of paying carriage over again to his own place.

THE PHYSICAL SOCIETY EXHIBITION.

(*Concluded from page* 53.)

Weston Electrical Instrument Co.

A large variety of switchboard and portable instruments of the dynamometer, permanent-magnet, moving-coil, and iron types was exhibited, together with interesting power factor, frequency and wattmeters, and a new synchroscope—all of which were excellent

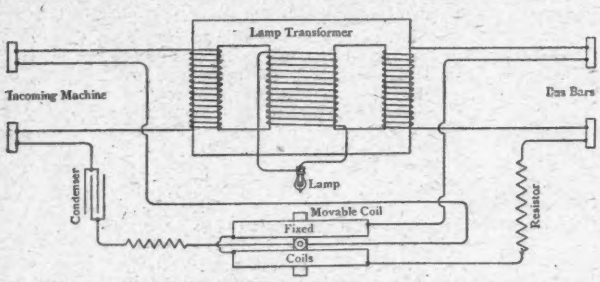


Fig. 14.—Diagram of Connections of Synchroscope.

illustrations of the beautiful workmanship and skilled design which have always characterised the Weston instruments. Delicacy combined with strength is a marked feature of the movements, and it is interesting to see the principles which guide the designer of heavy structures embodied in the construction, for example, of a delicate pointer, which is, in fact, described as "a triangular truss with tubular members." The total weight of the movable system of a Weston single-phase wattmeter is only 1·84 grammes, and the power consumed at full load is less than 4 watts at 110 volts; the accuracy of the readings is practically independent of frequency, power factor and temperature.

The new synchroscope is not of the rotating type; it operates on a novel principle, the mechanism being very similar to that of the single-phase wattmeter, except that both fixed and movable coils are wound with fine wire. The connections are shown in the accompanying diagram, fig. 14, and the appearance of the instrument is represented in fig. 15. A lamp is inserted behind the dial, and throws the shadow of the pointer upon the latter; in this lies the novel and extremely ingenious device upon which the working of the instrument depends.

The two circuits of the wattmeter mechanism, as shown in the diagram, are in series respectively with a condenser and an inductance coil, so adjusted that when the applied pressures are in phase, the currents are in quadrature, and instead of the maximum deflection, the pointer stands at zero. If the pressures are out of phase, the pointer will be deflected to one side or the other, depending on which is the leading pressure, and when the pressures are exactly opposite the pointer again stands at zero. Thus, if one circuit is connected to the bus-bars and the other to the incoming machine, the pointer will oscillate to right and left. But the lamp at the same time is lighted and extinguished in the usual way, and as it is out when the pressures are in opposite phase, the passage of the pointer through zero at this moment cannot be seen. The result is that when the incoming machine is running too fast, the pointer is only seen while it is moving from left to right, giving a perfect illusion of continuous revolution.

Similarly, when the incoming machine is slow, the pointer appears to revolve in the opposite direction. Finally, when the speed is right and both pressures are in phase, the pointer stands at the zero index mark, and the lamp is bright. It is impossible to mistake the indications of this beautiful device, which shows to a very close approximation the relation between the phases, and clearly indicates which machine is the faster.

In the Weston power-factor meter, which is a special form of the electro-dynamometer, the movable system consists of two circular coils mounted on the same staff in planes at right angles to one another; one is not slipped inside the other, as this would render magnetic equality impossible—the coils are actually interlaced, layer by layer, where they cross and are thus practically identical.

The frequency meter is illustrated herewith, without the cover; it has a soft-iron needle, with two fixed coils at right angles, and the movable system is uncontrolled. A resistance and inductance are connected in series across the mains; one coil in series with an inductance is then joined across the resistance, and the other coil in series with resistance is joined across the inductance. The arrangement then forms a kind of Wheatstone bridge, which is balanced at normal frequency, but any change in the frequency will upset the balance and cause a corresponding deflection of the pointer. It will be seen that a very open and uniform scale is obtained, with a high degree of accuracy. The higher harmonics are damped out with an extra inductance.

Harry W. Cox & Co., Ltd.

An interesting item of this exhibit was Mr. B. H. Morphy's flux-meter, consisting of a small coil carried on a frame suitable for insertion into the air-gap of a dynamo, and provided with an arrangement of lamp, mirrors and scale to indicate the deflection when a small current was passed through the coil. The latter being mounted on a radial arm could be moved to various positions, and the field in the air-gap could thus be plotted, under all conditions of loading.

A new glass, made with lithium and twice as permeable to X-rays as soda glass, was shown in use, fitted into an X-ray tube.

Gambrell Bros.

This firm exhibited Dr. Lowndes's thermo-electric potentiometer, having a range of 0-5,000 microvolts and designed for the measurement of the small E.M.F.'s obtained from thermo-elements; a new pattern of discharge key for insulation resistance testing, &c, and a variety of other apparatus.

R. & J. Beck, Ltd.

A new model of photometer—the "Holophane Lumeter"—was shown by this firm; it is a portable instrument consisting of a small box, fig. 17, in which an illuminated disk C can be seen, with an aperture D in the centre through which the surface to be tested is viewed. By turning a pointer H on the top of the box the brightness of the disk can be adjusted to equality with that of the object, and is read on a scale of candle-feet K. The range of the instrument is from $\frac{1}{100}$ to 2,000 candle-feet. The screen is illuminated by an incandescent electric lamp B and storage battery. For testing the illumination of a horizontal surface, a screen can be supplied which automatically takes up a horizontal position without levelling, and a daylight attachment is also made.

Fig. 15.—Phantom View of Synchroscope.

Fig. 16.—Frequency Meter, without the Cover.

Another exhibit was Dow's new candle-power standard, an extremely ingenious device in which two lamps are used—one a carbon, the other a metallic-filament lamp. The brightness of these lamps varies with the current according to different laws, and by varying the current a point can be found at which the two

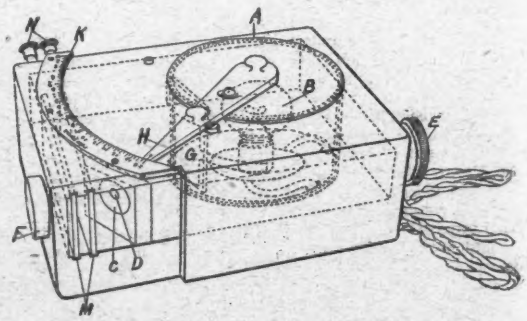


Fig. 17.—The Holophane Lumeter.

lamps are of exactly equal power, as judged by a photometer; this is then a standard C.P., which can always be set independently of the supply voltage or any other external condition.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Adams "Igranic" Semi-Automatic Machine Starters.

The ADAMS MANUFACTURING CO., LTD., of Bedford, have introduced a series of semi-automatic starters for motors of small size, which ensure full protection for the machine and the starting-resistance at all times, one of which is illustrated in the accompanying figures. After closing the main switch shown below the starter, the handle of the latter is raised, and by this movement the circuit is closed through all the starting resistance. The weighted resistance arm then falls by gravity against the action of a dashpot, gradually cutting out the resistance. The main circuit is opened on the failure of supply, or on pressure of a releasing button attached to the case of the starter, or of distant stop push-buttons. A separate regulator can be mounted on the same frame for shunt speed regulation if desired. The rate of starting can be varied by adjusting the dashpot. It will be seen that, after closing the main switch, only one operation is required to start the motor.

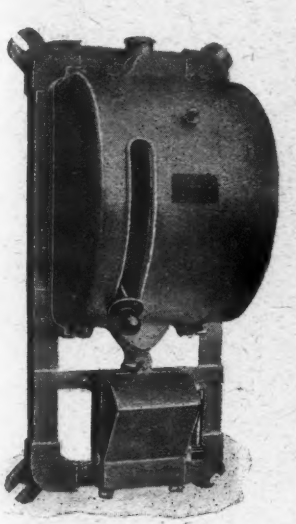


FIG. 1.—COMPLETE SEMI-AUTOMATIC STARTER.

FIG. 2.—STARTER WITH COVERS REMOVED.

Dowsing Cooking Range.

THE DOWSING RADIANT HEAT CO., LTD., of 105, Great Portland Street, W., have introduced an electric cooking range, of which we give an illustration, fig. 3. The oven is heated from the outside, and takes a maximum of 3,000 watts; a grill is provided on the top of the oven for grilling and toasting, taking 1,200 watts, and there are two hot plates taking 1,100 and 700 watts respectively, with lower heats controlled by switches. A smaller range is also made.

The oven will cook a three-course dinner for 12 people, consuming about 6 units; an ordinary breakfast for 12 people, consisting of bacon, eggs, toast, and boiling water (¾ of a pint per person) would require from 1½ to 2 units, and a lunch for 12 persons, 3½ units. These figures are taken from practical tests.

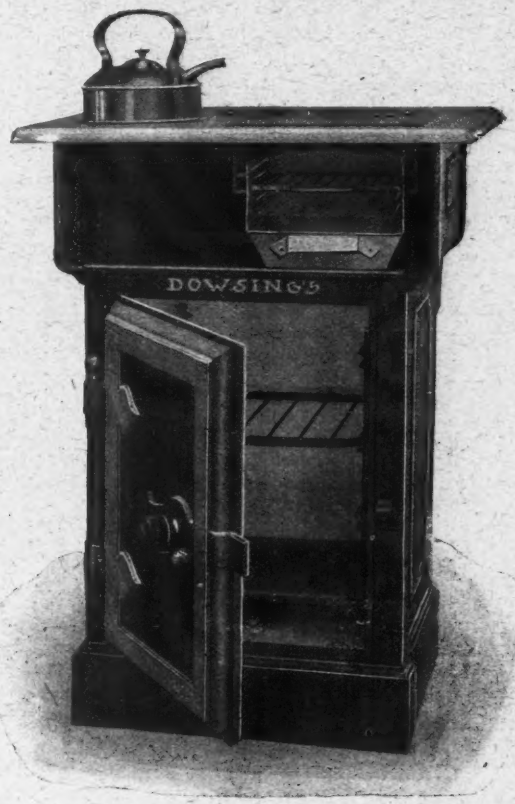
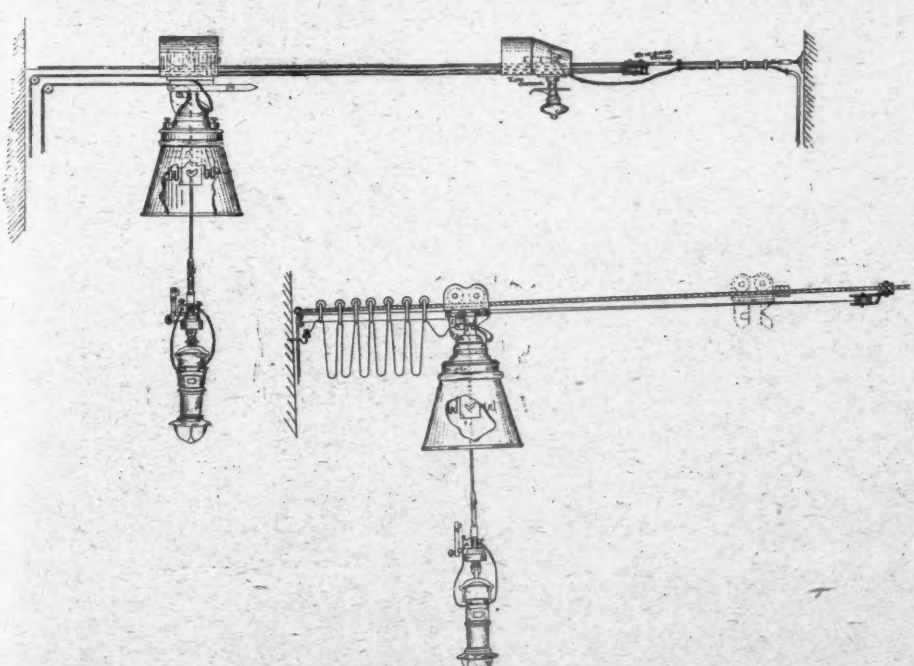


FIG. 3.—DOWSING ELECTRIC COOKING RANGE.

Arc Lamp Lowering Gear.

THE NORTH-WESTERN ELECTRICAL APPLIANCE CO., of Darlington (formerly Cathcart, Glasgow), who make a special line of the above, have sent us some illustrations showing recent developments in connection with their equipments of arc lamp lowering gear.

Fig. 6 shows a new type of central carrier lowering head, which is operated by a single rope. The gear is the company's standard



FIGS. 4 AND 5.—TYPES OF SPAN-WIRE LAMP SUSPENSIONS

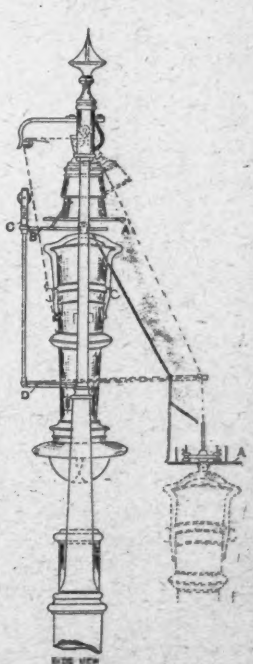


FIG. 6.—CENTRAL CARRIER LOWERING HEAD.

pattern No. 3 clip design, and has a disk of metal A attached to the lowering flange; this disk lowers on to a special-shaped fork B attached at right angles to an upright lever-arm C. When the lamp is lowered on to this, its weight carries the lever outwards. The lever-arm has a broad grooved pulley which engages with the rope, and when it is in position the lamp is lowered. The fork is so designed as to catch the plate when the lamp is being raised and lever the lamp into position and guide it up into the suspension and contacts. The attachments are very simple, and we are informed that the device is reliable and efficient. Old frames can be readily adapted to suit this lowering equipment. No unsightly span rods, or costly inner frame, are required. The gear is operated by a single rope from the side, there being no skill required in operating, as the self-sustaining direct-wind winch prevents any sudden jarring or rough usage by unskilled or careless operators.

Figs. 4, 5 and 7 show their span-wire side lowering equipments with lamp, and span-rope automatic contacts and suspension gears. Fig. 5 shows a simple and cheap arrangement; the cable is suspended on pulleys and cleats on the span-wire, and folds into the side. The lamp does not lower until it is brought to the side, and thus avoids fouling overhead wires and street traffic.

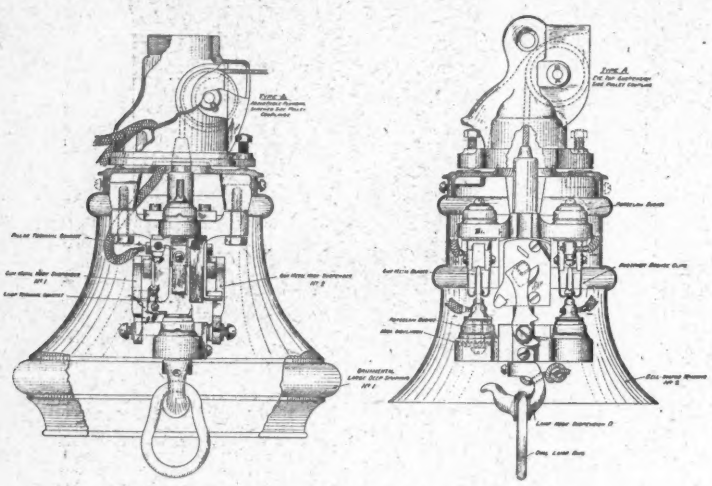


FIG. 7.—AUTOMATIC CONTACT SUSPENSION GEAR.

The company have a simple automatic suspension (only) side lowering equipment in which the cable swings down with the lamp. They also supply span-rope clamp-pulley couplings for attaching their ordinary gears to span wires, for lowering the lamps in the centre of the street instead of at the side. This arrangement, although cheaper and the simplest possible arrangement, is not suitable for busy thoroughfares.

Their Nos. 2 and 3 gears have undergone many important minor improvements and developments since they were last reviewed in our pages. We understand that they have been largely adopted by Glasgow, Belfast, Dublin, Bristol, Newcastle and other Corporations, &c., and by the British Admiralty.

The firm have recently introduced new patent gears for automatically short-circuiting the contacts when the lamp is lowered, so as to preserve the continuity of the circuit when the lamp is removed for trimming or repairs, either throwing the extra voltage into the circuit, or absorbing it through a substitutional resistance to preserve the correct voltage to the other lamps in the circuit. This enables a considerable saving in the first cost to be effected, namely, the cost of an isolating switch and automatic cut-out at the pillar base, besides other apparent advantages, such as giving a ready means of detecting faulty lamps.

Their arc lamp winch is exceedingly simple in construction, and is an ingenious adaptation of the coil-clutch principle; it gives a direct wind or unwind of about 14 in. per revolution, and is self-sustaining in all positions.

New Patent Earthing Clip.

A neat clip for earthing electrical circuits or earth wires to pipes has been put on the market by MR. A. E. INGLE, of 13, Albert Place, Bridge Street, Manchester. As illustrated, it consists of two

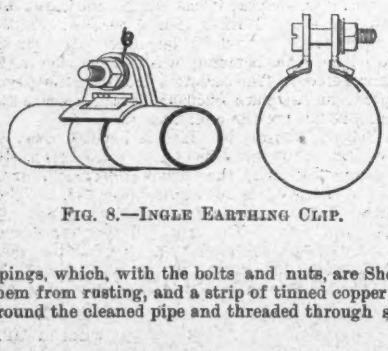


FIG. 8.—INGLE EARTHING CLIP.

iron stampings, which, with the bolts and nuts, are Sherardised to prevent them from rusting, and a strip of tinned copper; the latter is passed round the cleaned pipe and threaded through slots in the stampings, which are then drawn together with the bolts. As the copper tape is cut off a bobbin to suit the circumference of the pipe, and the same stampings are always used, only one size of clip need be kept in stock; if necessary, two or three thicknesses of tape may be used, where the earth current is likely to be heavy. The stampings and tape are supplied in two standard sizes. It will be noticed that the clip is also suitable for earthing or bonding the sheathing of electric cables, and conduits.

"Korfund" Foundation Plates.

THE KORFUND CO., of 47, Victoria Street, S.W., are introducing into this country their patent foundation-plates, which are made of strips of selected cork, treated so as to preserve their elasticity and resiliency, and bound together in iron frames, stiffened by tie-bars. The plates are made in various sizes, and are laid under the foundation block, covering the whole area. The cork, in the substance of which air is imprisoned, acts like a pneumatic cushion, and thus forms an admirable anti-vibration layer; it is claimed that, unlike rubber and felt, the cork retains its elasticity permanently. Fig. 9 shows in section the application of "Korfund" to the foundation of a Diesel engine, for which purpose it has been very widely used on the Continent; it has also been adopted for elevator apparatus, gas engines, electric motors, &c. It is made in two thicknesses—1½ in. and 2⅜ in.

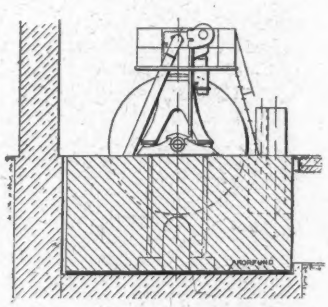


FIG. 9.—"KORFUND" FOUNDATION PLATE FOR DIESEL ENGINE.

Sloan Insulators.

Amongst the many insulator specialities which appear in the recent list issued by the SLOAN ELECTRICAL CO., LTD., of Conradty

FIG. 10.

House, Golden Lane, may be mentioned a series of resistance plates, fig. 10, which can be built up to form a resistance of desired

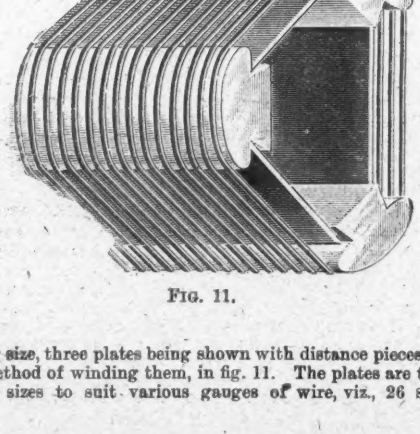


FIG. 11.

length or size, three plates being shown with distance pieces, as well as the method of winding them, in fig. 11. The plates are threaded different sizes to suit various gauges of wire, viz., 26 S.W.G. to

FIG. 12.—BUTTON INSULATOR.

14 S.W.G. An ingenious two-part button insulator for fixing flexible cord is shown in fig. 12 : this insulator does not injure the flexible, and is made $\frac{5}{8}$ in. in diameter, with a $\frac{3}{16}$-in. hole.

"Reyrolle" 10-Ampere Mining Circuit-Breaker.

MESSRS. A. REYROLLE & CO., LTD., of Hebburn-on-Tyne, have designed a 10-ampere circuit-breaker to meet the rapidly increasing demand for some means of controlling small circuits in collieries, and to supersede fuses, which are entirely out of place in a pit. As will be seen from the illustration, the circuit-breaker is of the double-pole type, enclosed in a flame-proof and explosion-proof case

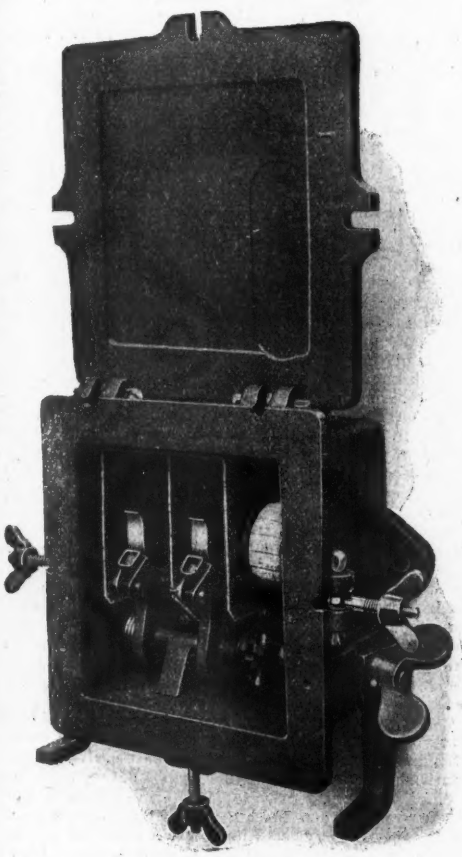


FIG. 13.—REYROLLE 10-AMPERE CIRCUIT-BREAKER.

and fitted with a cover having a broad machined face joint. The cover can be removed only when the switch is in the "off" position, and the switch cannot be put "on" until the cover is in place, so that carelessness on the part of the attendant is guarded against to a considerable extent. The circuit-breaker is of the free-handle type, and has overload protection on both poles.

Graphite Lubricants.—As we have received many inquiries for the address of agents for the Acheson "Aquadag," "Oildag," &c., and are unable to ascertain that these lubricants are at present on sale in this country, we may save inquirers trouble by stating that the address of the makers is the "International Acheson Graphite Co., N.Y., U.S.A."

Shops Act, 1911.—MESSRS. OETZMANN & CO., LTD., write as follows :—"In view of the coming into operation of the above Act on May 1st next, it appears to us that, if it be then desirable to curtail the hours of business, it is equally desirable that they should be shortened now. We have decided, therefore, to close our establishment on Saturdays at 1 o'clock instead of at 2 o'clock, commencing Saturday, 20th inst., and, in order to avoid any inconvenience to the shopping public, may we beg the courtesy of your columns."

BUSINESS NOTES.

New Zealand.—The New Zealand Customs authorities have recently given a decision to the effect that "Electrical appliances, viz., electric cables in sets, with terminals affixed, enclosed in flexible tube," are to be classified under No. 176 of the Tariff, the duty being at the rate of 30 per cent. *ad valorem* on foreign productions, and 20 per cent. on British goods.

Japan.—According to a recent official return the number of electrical companies registered in Japan at the end of September last was 1,016, the aggregate capital of the same being £35,517,973. For the supply of electricity, there are in the country 186 concerns, while 15 are operating electric tramways, 25 working tramways and supplying current for lighting purposes, 697 are private concerns and 93 are controlled by the Government. At the date named 168 other concerns had secured charters, but had not yet commenced operations.

In cases of signing contracts for sole representation in Japan, the *Elektrotechnische Nachrichten* points out that it is needful to particularise the territories intended, as the old term Japan may be interpreted to apply to Japan proper only, and not to the land acquisitions recently made, including Korea.

Tramcar Meters. — We learn that Chamberlain and Hookham ampere-hour car meters are being installed on the Delhi tramcars. MESSRS. VENNER & CO. have also received an order for 21 meters to equip the Ilford cars. The Nottingham Corporation is going to install the firm's type of meter on its cars, and has placed with it an order for the first 100.

Geipel Traps. — MESSRS. WILLIAM GEIPEL & CO. report a satisfactory increase in sales of the Geipel steam traps during 1911. For high-pressure work and large discharge their "Rapidity" trap has now replaced the ordinary Geipel trap. They have also during the year introduced, for low-pressure purposes, a new type of trap called Geipel's Spirit Trap, which operates by the expansion of spirit, the spirit being contained in a cylinder, the two ends of which are formed of flexible diaphragms. A special form of this trap is supplied for the purpose of draining railway carriage heating apparatus.

Messrs. Geipel report that the results of their trading for the year 1911 have shown a considerable increase on 1910, and, in fact, upon any year since they took over the business of Messrs. Paterson & Cooper. They inform us that they have been particularly busy in their cable and carbon departments, as well as in the works which they have equipped for turning out motor-controlling apparatus. Considerable success has also attended the sale of their new Time Switch, of which the Manchester Corporation alone has over 100 in use. Further improvements have been made in Henrion carbons, particularly in their flame carbons, with the result that the business in the latter has shown a substantial increase. Yearly contracts have been obtained from some of the leading local authorities using flame arc lamps, as well as from various of the most important industrial concerns.

Consular Notes.—Brazil.—The British Consul at Sao Paulo reports that the abundance of hydraulic power which exists throughout the State of Sao Paulo constitutes one of the most valuable natural assets of the State. The principal waterfalls are as follows :—In the course of the Rio Grande, 600,000 H.P. ; Rio Parana, 447,000 ; Rio Tiete, 159,300 ; Rio Juquery, 50,000 ; Rio Branco, 15,000 = 1,271,300. In addition to the above principal falls there exist a vast number of lesser falls distributed through the State, and such wide distribution is undoubtedly an advantage. There exist in the course of the Riberia de Ignapa 10 considerable falls ; of the Rio Juguia and its tributaries 10 or more falls ; of the Rio Paranapanema nine falls, besides many others along the slopes of the Sierra do Mar. The amount of hydraulic force actually utilised in the State at the present time represents some 80,000 H.P. Rights pertaining to the unexploited falls above mentioned are mostly vested in the State Government. The Sao Paulo Tramway Light and Power Co., Ltd., occupies a position of much importance in the city of Sao Paulo. The company was incorporated in April, 1899, under the constitution of the laws of the State of Maine, U.S.A., for the purpose of exploiting certain concessions (practically perpetual) for running street railways and for the supply of electric light and power for industrial and other purposes in the city of Sao Paulo. The company generates its electrical energy from a waterfall of the Rio Tiete, which it possesses, situated 23 miles from the city, capable of developing up to 60,000 H.P. Power is conveyed by a transmission line built upon the company's private right of way. The company works 105 miles of tramway in the city and surrounding districts. It supplies light to over 5,000 customers using some 72,000 lamps, and power to over 500 customers using nearly 15,000 H.P. The working of the Sao Paulo Tramway, Light and Power Co. has proved very successful from its inception, and year by year it has earned increased dividends for its shareholders, viz. :—During 1904, 7 per cent. ; 1905-6, 8 per cent. ; 1907, 9 per cent. ; 1908-9, 10 per cent. ; 1910, 13 per cent. At the close of 1910 the company was in a position highly gratifying to the shareholders. The directors decided, after paying a dividend of 13 per cent., to place £200,000 to the reserve fund and to carry forward £273,000 to the next account.

Bavaria.—The British Consul in Bavaria reports that the Bavarian Ministry of Communications have reserved to themselves for the purpose of electrification of the State Railways, the exclusive use of seven distinct sources of water-power, viz. :—Those obtainable from Lake Walchensee and from the Rivers Isar, Alz, Lech, Iller, Saalach and Lin. The rest of the water-power belonging to the Bavarian Government, amounting to about 500,000 H.P., which includes the Rivers Danube and Loisach, will be at the disposal of private enterprise. It is considered that, even

if this power is fully utilised, Bavaria will not be able to produce a quantity of electrical energy equal to the average of the rest of the German Empire, which is stated to be 15 KW. per head (Bavaria, 10 KW.). The differences between the Bavarian and the Austro-Hungarian Governments respecting the use—for generating electricity—of the River Ache and the Achensee on the frontier, which together would yield 44,000 H.P., have not yet been settled. These watercourses, rising on Austro-Hungarian territory, flow into Bavaria, and the Government of the latter country contend that Austria-Hungary has no right to claim the sole use of this power, whilst the Government of the Dual Monarchy argue that every country may unreservedly dispose of such watercourses as are within its limits. Austria-Hungary claims as compensation, if she is to give up her intention of using this water-power, the right to construct a railway connecting the Tyrol with Salzburg, which would lead through Bavarian territory near Reichenhall. This scheme is rejected, however, as the Bavarian State Railways would lose a considerable amount of traffic in Bavaria proper by the projected Austro-Hungarian line. The whole question will probably be brought before an arbitration court. The water-power of the River Isar is now being used in Munich to the amount of 3,500 H.P. in over 100 works, of which the municipality own eight and the Government four. The Bavarian Home Office granted in 1911 to a private firm the concession to utilise the water-power of the River Ammer between Unterammergau and Ammersee, a lake in the neighbourhood of Munich. The water-power obtainable is estimated to be about 28,000 H.P. Another important undertaking of the same kind will be the Leitzach Works in Upper Bavaria, utilising the waters of the River Leitzach and of the Seehamer Lake. The works, of about 10,000 H.P., will provide four large districts with electric light and power. The Bavarian Government—in order to prevent parishes wishing for the introduction of electric power being charged too high rates by private firms—offer the free advice of their official experts, who also invite tenders and examine those submitted.

Great efforts are being made to introduce ploughing by electricity in Bavaria. A society has been formed whose object is to undertake trials with the electric plough, and, for that purpose, to arrange for the necessary supply of power, which is to be provided by the Amper Works, near Munich. The trials made near the latter town, proved most successful, and will probably lead to the general introduction of electric ploughing wherever the requisite power is available.

Poland.—The British Consul at Warsaw calls attention to the fact that electric light is practically always installed in new buildings there, either alone or in conjunction with gas. Birmingham electroliers and electric light accessories are both cheaper and better than those procured in Germany, but British manufacturers in these lines are very little represented in Warsaw. The increasing demand for electricity in Warsaw may be seen from the following table :—

	Dec. 31, 1909.	*Dec.* 31, 1910.
Users for lighting purposes...	2,405	4,700
„ power purposes ...	737	
Consumption for lighting ...	2,904·261 KW.	3,435·000 KW.
„ „ power ...	2,260·888 KW.	3,365·000 KW.

Prices remained the same. The number of town subscribers to the Warsaw system of telephones reached 22,445, as against 17,744 in the previous year. Suburban and long-distance subscribers also increased. The project of the Warsaw-Lublin line was not carried into effect, nor were any other provincial towns supplied. In Lodz, as may readily be supposed, owing to the general development, the system is annually being extended.

Private Meeting.—BOHM LENS LAMP CO., LTD., 15, Great St. Helens, E.C., electric lamp manufacturers.—A meeting of the creditors herein was held at the offices of the company on the 9th inst., having been convened by the liquidator, Mr. Edward S. Neave. A statement of affairs presented showed liabilities to unsecured creditors, £1,553. The assets consisted only of £34, being the balance resulting from the sale of patents. It appears that the company has not been trading for some months past. No proposition was before the meeting, and the appointment of Mr. Neave as voluntary liquidator was confirmed. The following are creditors :—

B. N. C., Ltd.	£476
Edison & Swan United Electric Light Co.	32
Neave, R. & T.	115
Albion Electric Works	32
B. N. C., Ltd.	861
Secured creditor—	
Neave	600

Supper.—The staffs of Blackpool Tramways and Electricity Departments joined round the festive board at the Wellington and Pier Hotel, on January 10th, and a pleasant evening was spent by over 100 men. The men on duty in both departments that evening had their gathering on January 11th, when there was another happy company at the hotel. Mr. Chas. Furness, head of the tramways and electricity departments, presided. Mr. Furness proposed the "Mayor and Corporation." Alderman Brodie responded. Councillor Bean proposed "The Blackpool Corporation Tramway and Electricity Departments."

The Machine Tool Association.—On January 11th the first annual meeting of the Machine Tool and Engineering Association was held at the Midland Hotel, Manchester. The report stated that the membership was now 80, 43 firms having joined since the statutory meeting in March last. They had been in communication with the Home Office during the year respecting the adequate guarding of gear wheels of machines. It appeared that foreign manufacturers supplied their machines adequately guarded, but British firms had lost orders, because they had failed to do so. The Association strongly advises its members to act upon the suggestions of the Home Office in this matter. Of the available space (£13,500) at the Machine Tool Exhibition of October next, £8,000 has already been definitely let. There will be a supply of electric power, steam, and compressed air for the purpose of operating the exhibits. During the year several members applied to the Association for permission to show at various exhibitions, "and permission has been given or refused according to the circumstances of the case." The number of founders' shares subscribed is 1,499 at 5s. each = £374 15s.

The Trade Prospects of Indo-China.—In the course of a very interesting report on the trade of French Indo-China, U.S. Consul General George E. Anderson, Hong Kong, says that Indo-China has come to be a trade factor of importance in the Far East and in countries trading with the Far East. Its advancement along all lines has been rapid but at the same time safe. Its trade recently has been interfered with somewhat by a lack of proper trade facilities, since its advancement has outstripped its development in such things as port improvements and commercial machinery. But the development of the country along modern lines in agriculture and in some branches of industry, and the opening up of some of its natural resources, have brought notable results and promise still greater achievements in the immediate future.

New industries are being established on an increasing scale. Three large cotton factories have been started and are reported a great success on the whole—one at Haiphong with 25,000 spindles, one at Nam Dinh with 24,000 spindles, and one at Hanoi with 10,000 spindles. The three factories produced somewhat over 351 metric tons of cotton yarn from native cotton during last year.

In Hanoi there is a large ice factory, also a match factory, a large paper-making establishment about to be put in operation, several distilleries, a brewery, furniture factories, and similar establishments. The great cement establishment at Haiphong is already one of the notable factors in export trade. During the past 10 years the cities have been laid out upon a modern plan, great waterworks establishments have been installed, the cities are lighted by electricity, the larger ones are equipped with tramways, telephone and similar conveniences, and even a subsidised opera season in theatres of more than ordinary quality is a feature of the life of the people.

Mines are being opened up, as is evidenced by increased output of zinc and other metals.

The most notable advance, however, has been in matters of communication—an advance which may be taken as largely the basis of all other improvement. During the past year the railway into Yunnan has been completed, and several lines in Indo-China itself extended ; besides these improvements there were the inauguration of boat services upon several rivers, the extension of telegraph and telephone services between districts, the construction of automobile roads in various directions, and the establishment of a fairly complete wireless telegraph system all over the country.

The most notable of these accomplishments is the completion of the line into China. While the matter of further extension of these lines in keeping with French plans is held in abeyance, it is nevertheless a fact that the most practicable route from the seaboard into Szechwan Province and the great inland Empire of west China, is over this new railway through Indo-China and Yunnan Province.

The only serious drawback to the development of this interior trade along new lines is the fact that the French colony charges 20 per cent. of its full import duty on goods entering Indo-China as a transit duty across Indo-China into Yunnan and Kwangsi Provinces. This transit duty is large enough to overcome the advantage of rail haul on foreign goods going into west China, and, in spite of the railway facilities, the trade returns from Customs stations like Tang Yueh in west China show substantially the same trade in goods imported by mule back from India that has been had heretofore and before the railway's service to Yunnan and Szechwan was possible. Such goods have actually been delivered in Yunnan Province itself after 32 days' transportation on mule back in direct competition with railway-borne goods.

Book Notices.—*The Commerce of Cape Town.*—The commercial, agricultural, and manufacturing opportunities of the City of Cape Town are set forth in an official handbook, "The Industrial and Commercial Inducements of Cape Town," compiled under the joint auspices of the Corporation of the City of Cape Town and the South African Railway Administration. The book briefly reviews facts with which the manufacturer who is considering the possibilities of Cape Town as a centre for the establishment of a local factory, will desire to be acquainted. For the establishment of factories in Cape Town and district, the handbook contains much useful statistical information and a number of illustrations. Copies of the handbook may be obtained free on application to the office of the High Commissioner for the Union of South Africa, 32, Victoria Street, London, S.W.

The Rubber Industry. Edited by Dr. J. Torrey and A. Staines Manders. 1912. London : International Rubber and Allied Trades Exhibition, Ltd. Price 15s. 6d. net.—This volume is the official report of the proceedings at the International Rubber Congress, held at the International Exhibition of 1911. It contains numerous papers on the question of rubber planting by experts, and on various other features of the rubber industry, from the treatment of the rubber trees to the manufacturing processes and tests, as well as a full report of the Exhibition. At a meeting of planters, chemists and manufacturers, the problem of the maintenance of a uniform standard of quality was discussed, and the extreme

difficulty of devising reliable tests for rubber was clearly evidenced. The chairman suggested that, as the real test came at the vulcanising stage, the planter should carry out vulcanising tests on the plantation, so as to master the lack of uniformity, which was "the growing evil of the whole planting industry." An important paper on "Mechanical Tests for Rubber" was read by Mr. K. Memmler, who described the methods experimented with at the Royal Prussian Testing Office of Gross-Lichterfelde. The subject of testing was also discussed by the India-Rubber Testing Committee. As a record of the work done at these and other meetings, the volume will be of permanent value to those engaged in the rubber industry.

British Standard Definitions of Yield Point and Elastic Limit.—This is a leaflet (Report No. 56) issued gratis by the Engineering Standards Committee (post free 1d.), in response to a request that standard definitions of these terms should be formulated.

"Quarterly Trade Journal of the British Chamber of Commerce of Turkey." December, 1911. Constantinople: The Chamber. Price 2s. 6d.

"Atti della Associazione Elettrotecnica Italiana." November, 1911. Milan: Stucchi, Ceretti e C.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXI, No. 1. January, 1912. New York: The Institute. Price $1.

"Alternating-Current Design." By Julius Frith. 1911. London: Harper & Bros. Price 5s. net.

"*Journal* of the United States Artillery." Vol. XXXVI, No. 3. November-December. 1911. With Index to Vol. XXXVI. Fort Monroe, Va.: Coast Artillery School Press.

"The Post Office Electrical Engineers' Journal." Vol. IV, Part 4. January, 1912. London: H. Alabaster, Gatehouse & Co. Price 1s. net.

"Machine Tools." By James Weir French. 2 Vols. 1911. London: The Gresham Publishing Co. Price 42s. net.

"Laboratory Exercises in Physical Chemistry." By J. N. Pring. 1911. London: Sherratt & Hughes. Price 4s. net.

Canada.—H.M. Trade Commissioner for Canada reports that the stock of catalogues of the city engineer of a town in Western Canada has been destroyed, and suggests that firms interested in water-works, tram lines, telephone lines, &c., should forward copies of their catalogues. The name of the town referred to may be obtained by British contractors and manufacturers on application to the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

Calendars and Catalogues. — THE WESTINGHOUSE BRAKE CO., LTD., 82, York Road, King's Cross, London, N.—We have received a large hanging wall calendar with monthly tear-off slips, the general design including views of Westinghouse (Morse) rocker-joint silent chain drives.

THE DOMINION BELTING CO., 91, Minories, London, E.C.—52-page catalogue containing illustrations and particulars relating to the firm's leather and textile beltings. Prices are fully tabulated for Balata, hair, cotton, duck, leather, "Pyramid" cotton, vulcanised india-rubber and other beltings, also ropes, laces and sundries. The company have recently fitted up their works with modern and improved machinery.

MESSRS. DICK, KERR & CO., LTD., Abchurch Yard, Cannon Street, London, E.C.—New catalogue of 20 pages (art paper) containing description and excellent illustrations of various forms of their automatic metallic shield blow-out circuit breakers for continuous currents for power and traction work, for which numerous repeat orders have been received from Governments, municipalities, mines, and other power-users. Line diagrams, tabulated prices, catalogue numbers and dimensions are given.

THE VALOR CO., LTD., Rocky Lane, Aston Cross, Birmingham.—Leaflet relating to their "Perfection" oil heating stoves.

MESSRS. ALFRED HERBERT, LTD., Coventry.—Finely got-up brochure, describing and illustrating their automatic stud machine with sliding turret.

THE BRITISH THOMSON-HOUSTON CO., LTD., Mazda House, 77, Upper Thames Street, London, E.C.—A booklet has just been issued containing extracts from British technical and other papers regarding the Mazda drawn-wire filament lamps. They have also prepared a very attractive postcard illustrating their show-card design of the "Mazda" lamp—in which against a circular red background a clenched fist is shown striking a lamp, emphasising the strength quality of the Mazda lamp. Both these publications are intended for the use of contractors and others in their business, and contractors who have not yet received a supply with their name printed on them should apply to the above address.

THE ARMORDUCT MANUFACTURING CO., LTD., of Farringdon Avenue, London, E.C., are once again supplying their friends with refills for their perpetual desk calendar issued several years ago. During 1912 on these daily slips reminders of future engagements may be indicated, the whole being preserved as a complete record of one's movements for reference.

MESSRS. MAGIC APPLIANCES, LTD., 6, Farringdon Avenue, London, E.C.—New edition of their booklet (42 pages) containing a description, and many interesting illustrations showing the application, of the "Magic" British-made suction cleaner.

MESSRS. KELVIN & JAMES WHITE, LTD., 18, Cambridge Street, Glasgow.—Pamphlet No. 5 revised, containing a full and illustrated description of Lord Kelvin's multicellular electrostatic voltmeters (1911 pattern) with multipliers.

MESSRS. FREDK. THOMAS & CO., 189, Drummond Street, Hampstead Road, London.—12-page art pamphlet showing illustrations and stating prices of a choice selection of cast-brass candlesticks adaptable for electric lighting, and other metal work. Also a leaflet showing illustrations of a number of designs of luminous radiators, with iron and polished-brass frames. The firm makes a special feature of artistic electric light fittings in metal.

MESSRS. W. GEIPEL & CO., Vulcan Works, St. Thomas Street, London, S.E.—Pamphlet relating to aluminium for electrical conductors, giving extracts from reports, &c., by users in U.S.A., notes on erecting and jointing, and a table of diameters, areas, resistances, weights, &c.

THE BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—Price list No. 325, containing a description, with diagrams of connections for A.C. and for D.C., of their "Winkey" leakage detector for mining work, and of the B.T.-H. selective leakage protective device; also list No. 326 briefly describing, with illustrations and prices, the B.T.-H. non-luminous radiators of several types.

THE SAFETEE CONTROLLING APPLIANCES CO., Langley Street, Luton, Beds.—Eight-page pamphlet containing brief particulars, with illustrations and diagrams and notes of prices of the "Safetee" switch fuse. The firm are also makers of controlling motor-panels and main switchboards.

MESSRS. JAMES KEITH & BLACKMAN CO., LTD., of 27, Farringdon Avenue, London, E.C.—Two circulars have been received descriptive of the "K. B." portable air blower with electric motor combined for foundry moulds, and for expelling foul air from varnish tanks, brewers' vats, &c., also for use in other industries.

THE GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, London, E.C.—Catalogue of wires, cables and accessories (Section W., fourteenth edition, 64 pages). The opening pages contain a number of tables, including one of comparison of various wire gauges, particulars of copper conductors, wiring tables, and a price calculator table prepared with the idea of facilitating estimating and costing. The general contents of the catalogue comprise particulars, with illustrations, and plainly tabulated prices, of a variety of wires and cables, lighting flexible, lift and motor-car cables, bell and telephone wires, aerial line wires, insulating materials, insulators and tools. The firm holds a very large stock of goods covered in this department.

THE TURNBULL MOTOR WHEEL CO., Bishopbriggs, Glasgow.—Pamphlet relating to the "Bullturn" patent emergency motor wheel, which replaces a damaged tire.

MESSRS. PREMIER ELECTRIC HEATERS, LTD., 258-260, Bradford Street, Birmingham.—Leaflet illustrating, and giving prices of, the "Smoothwell" electric iron, and electric water and food heaters.

MESSRS. SYKES & SUGDEN, Spring Place Works, Huddersfield.—Eight-page pamphlet containing illustrated descriptions and prices of single and double-pole "Elixum" bridge fuse-boxes, ironclad switches, the "Elixum" combined supply set, service, junction and other boxes, knife switches, tubular fuses, and feeder pillars. Copies of this catalogue will be sent on application.

Dissolutions and Liquidations.—JOHNSON-LUNDELL ELECTRIC TRACTION CO., LTD.—At a meeting held at Cannon Street, Hotel, E.C., on December 21st, it was resolved to wind up voluntarily with Mr. A. E. Messer, 14, Old Jewry Chambers, E.C., as liquidator.

W. ROBSON & SONS, electrical and gas engineers, 226, Westminster Road, Kirkdale, Liverpool.—Messrs. W., T. W., and R. W. Robson have dissolved partnership. Messrs. W. & T. W. Robson will attend to debts, &c., and continue the business at the same address.

ELECTRIC AND GENERAL ASSURANCE, LTD.—Creditors must send particulars of their debts, &c., to the liquidator, Mr. Lionel Maltby, 5, London Wall Buildings, Finsbury Circus, E.C., by February 5th.

ELECTRIC INSTALLATION CO., LTD.—A meeting is to be held at 5, Clarence Street, Albert Square, Manchester, to hear an account of the winding up from the liquidator, Mr. J. Bell.

Trade Announcements.—MR. LANCE FEATHER has commenced business as an electrician at 50, Nelson Street, Bridlington.

The M. & C. MANUFACTURING CO. will in future be known as the Curtis Manufacturing Co., electrical manufacturing engineers. Their address is Conduit Place, Paddington, London, W. The firm are doing a good business in cinematograph resistances for the trade and for export.

Social and Dance.—MESSRS. GENT & CO., LTD., of the Faraday Works, Leicester, held their annual social and dance on Tuesday evening, the 9th inst., at the Queen's Hall in that town. The first part of the evening was devoted to a concert in which the following artistes gave their services:—Miss Hubbard, Mr. W. Atkinson, pianist; Mr. J. Monoghan, Mr. W. R. Chapman, Mr. J. O'Shea, Mr. R. Hart, Mr. Riley, and Mr. C. Newton. Mr. H. Parsons presided. After refreshments, the remainder of the evening was given up to dancing. A hornpipe and sword dance by the Misses Mabel Wilson and C. Skinner were also greatly enjoyed.

Annual Dinner.—The drawing office of the REES ROTURBO MANUFACTURING CO. held their second annual dinner and smoking concert at the Talbot Hotel, Wolverhampton, on Monday evening, under the chairmanship of Mr. G. J. Wheeler, chief draughtsman. A humorously-worded menu had been drawn up for the dinner, and the concert consisted of songs, recitations, and 'cello solos by members of the staff and others. Mr. Finnimore's services as accompanist at the piano were much appreciated. The toasts included "The King," "The Rees Roturbo Manufacturing Co.,"

"The Artists" and "The Chairman," and were heartily responded to. Mr. P. Alebon proposed the toast of "The Company," which was drunk with great enthusiasm. Cordial appreciation of the chairman and his services in the chair were voiced by several speakers, and his health was drunk with musical honours. In responding, the chairman held out very hopeful prospects for the future of the company, which, he said, since its reconstruction, had taken up an additional line of business—viz., hydraulic work. It was specialising in the various branches of work to which the Roturbo pumps could be applied, and he had no doubt that at no distant date the name of the Rees Roturbo Manufacturing Co. would be known not only from one end of the United Kingdom to the other, but throughout the world.

Bankruptcy Proceedings.—THOMAS TOPPING, electrical and mechanical engineer, 361, Lord Street, Southport, Lancaster.—Mr. Registrar Howarth held a sitting at the Court House, Government Buildings, Victoria Street, Liverpool, last Monday, for the public examination of the above-named debtor. The liabilities were put at £363, and the assets were estimated to produce £148. Mr. Hadfield appeared for the debtor. It transpired that the debtor started business on his own account in August, 1910, with a capital of £30, which he had saved while in employment. He attributed his present position to losses on contracts and bad trade. The furniture at his house was purchased by his father-in-law and given to his (debtor's) wife before their marriage. The debtor executed a deed of assignment for the benefit of his creditors on December 4th last, but the deed was not registered. He only became aware of his position about a month before filing his petition, probably about the beginning of last November. An adjournment was ordered.

LIGHTING and POWER NOTES.

Barnsley.—The B. of G. has decided to consider at its next meeting the following resolution which has been passed by the House Committee, viz.:—"That the time has now arrived when the question of supplying the workhouse with electric lighting should be considered, and that the Guardians be requested to appoint a Committee for the purpose."

The L.G.B. has sanctioned the borrowing of £4,620, making £17,100 in all, for electricity extensions. The time for repayment is 15 years.

Bath.—At a meeting of the Surveying Committee, a report was read from the Lighting Committee recommending that Queen Square, Wood Street, Charlotte Street, Queen's Parade Place, Chapel Row, Palace Mews, Princes Street, Harington Place, York Street, Old King Street, Queen Street and Queen's Parade, be lighted in future by 100-C P. electric lamps, costing the sum of £253. In regard to this, a letter was read from the secretary of the Gas Co., which had offered to light that area, or part of the area, at £2 10s. instead of £3 10s. a year per lamp, but arc lamps would then have to be removed by the Committee for which it would have to pay. After some discussion, the recommendation of the Committee was carried. The Committee also recommended that 23 electric lamps be placed on the line of new cable to be laid through Brougham Hayes to the new Co-operative Bakery, the first instalment in the added area.

Bedwas and Machen.—The joint Parish Councils have assented to an E.L. scheme for the district submitted by the South Wales E.L. Co.

Belfast.—At the last meeting of the Tramways and Electrical Committee, Mr. Bloxam, electrical engineer, reported that his negotiations with Messrs. Willans & Robinson, contractors for the duplicate turbo-dynamo and condensing plant, had been satisfactorily arranged, and he recommended that he should be authorised to place the order, which was done. Permission was also given for extensions of the mains on the Lisburn Road.

Bexhill.—Under ordinary circumstances a six weeks' supply of coal is kept at the Corporation electricity works; to guard against a strike, a special supply has been ordered which will secure the running of the works for ten weeks.

Birstall.—The U.D.C. has resolved that application be made to the B. of T. for a prov. order under the Electric Lighting Acts for the purpose of transferring the powers granted by the Birstall Electric Lighting Order, 1901, to the Electrical Distribution of Yorkshire, Ltd.

Bray.—The Urban Council has resolved to raise the sum of £3,500 for the purpose of extending the electric lighting works.

Burnham (Somerset).—The U.D.C. has decided to insert in the draft prov. order for E.L., a clause to enable the Council to dispose of the undertaking, if necessary, to the company. A L.G.B. inquiry into the subject is to be held.

Burnley.—The Corporation having consented to supply electricity in the residential district of Reedley Hallows, and having applied for a provisional order, the local authority has been informed that electricity would be supplied for lighting purposes at 4d. per unit; for heating and domestic appliances at 2d.: and for power the same as in Burnley plus an additional 33⅓ per cent. The supply will be given within three months of the order being received

Cheltenham.—The T.C. has received the sanction of the L.G.B. to a loan of £1,250 for a motor-generator, &c.

With reference to the extension order being applied for by the T.C., the Gloucestershire C.C. has decided to oppose it if, in the opinion of the Law and Parliamentary Committee, the order would be prejudicial to the county, unless satisfactory arrangements are made by the promoters. The order seeks to include in the area of supply ten rural parishes.

Chesterfield.—The T.C. has arranged to supply energy on a five years' agreement to Messrs. Eyre & Sons, Ltd., house furnishers, at ¾d. per unit for an annual consumption of 60,000 units.

Chile.—Don Pablo Fritz has obtained a concession for the establishment of an electric light service in the town of Pitrufquen. Twelve months are allowed for the completion of the work.—*Board of Trade Journal.*

Continental Notes.—NORWAY.—An interesting review of the water resources of Norway is given in a recent issue of the Christiania *Tidens Tegen*. Works supplying 490,000 H.P. have been completed and are in use, while others to a total of 430,000 H.P. are under construction. On the completion of the latter, the available water-power will be nearly doubled. Several of the large schemes, for which within the last 10 years concessions have been granted, are now approaching a finish. The Mjosen is almost completed; at Samnanger, whence the city of Bergen will draw its electric supply, the most important part of the work has just been completed; that on the Tyin has only recently been taken in hand. On the Maarsvand and the Totak, which will complete the depelopment scheme in the province of Telemarken, the distribution is deferred till the near future in consequence of the large sums which have had to be paid for expropriation. The great works contemplated near Matre and at Kinsaa, in the Hardangar district, have not yet been begun.

Besides the undertakings completed or under construction, there are the tenders for concessions which the Works Department has received for developing another 200,000 H.P.; on the Selbusjö, which the city of Drontheim will carry out, to provide 35,000 H.P.; then there are the three other large schemes—the Randsfjord, the Nidelv, near Arendal, and the Otteraa, near Christianssand. When these great works will be taken in hand cannot be said for certainty. From their importance they will probably come up for consideration in the next session of the Storthing.

The development on the Nidelv or River Nid, a matter of the first moment to the city and district of Arendal, will increase the present available 28,000 H.P. to 97,000 H.P.

The development of the Otteraa includes the damming of the Biglandsfjord and the use of a series of mountain streams in the east and north of the Sätersdal. By these works 80,000 H.P. will be made available, principally to the advantage of the flourishing industries in the neighbourhood of Christianssand. The matter came under the consideration of the Storthing in 1909, but on that occasion the damming of the Biglandsfjord failed to obtain approval.

The town of Hammerfest, which is the most northern town in the world, has been rebuilding its electrical works, which was one of the very first in Norway Previously the works were driven by steam, but water-power has now been adopted. Two generators of 360 H.P. each have been installed. The generated pressure is 3,000 volts, while energy is distributed at 220 volts for motors and 130 volts for lighting.

The new electrical works at Vardö have now been completed. A Diesel engine plant of 240 H.P. and dynamos of 30 KW. each, also an accumulator battery for 216 ampere-hours, are provided. Distribution is at 2 × 110 volts, and 2,500 lamps have been installed.

The Lilleström electrical works (in a suburb of Christiania) have also been completed. Energy is derived from Kykkelsrud, and alternating current is transmitted at 5,000 volts to four transformer stations, and there reduced in pressure to 220 volts for motors and 130 volts for lighting.

The town of Tromsö was one of the pioneer Norwegian towns in introducing electric lighting, for which purpose the energy was produced by means of steam power. The municipality has now decided on the harnessing of a waterfall at Simavik, situated about 20 miles from the town, which is capable of supplying 1,800 H.P. when fully developed. In the first instance only a part will be taken into use, and a sum of £27,777 was voted for the purpose of defraying the expenses in connection therewith. Owing to the town being situated on an island, the energy will have to be transmitted by a submarine cable for a distance of about ½ mile.

HOLLAND.—The district authorities of Wageningen, Holland, are contemplating the installation of an electric lighting plant.

GREECE.—It is proposed to install electric lighting in the town of Volo in Greece, and to effect this, a company with the title of "Société Electrique de Volo" has been founded. Manufacturers wishful to supply materials, machinery or apparatus necessary for the new installation, should apply to M. Glavani, the Mayor of Volo, who is director of the new company.

FRANCE.—The Compagnie Parisienne de Distribution d'Energie Electrique, which has carried on the supply of electricity to the whole city of Paris since 1908, intends to lower its prices on January 1st, 1913, and, in anticipation of a considerable increase in demand, has been reorganising its distribution system, erecting new substations, &c., without interruption to the existing service. The old generating stations are also to be superseded by two new works, one of 75,000 KW. at Saint-Ouen, the other of 25,000 KW. at Issy-les-Moulineaux, which are being equipped with generators of 10,000 KW. each. The company holds a monopoly of the lighting

supply, but not of power, and there is some talk of a new company with a capital of two millions sterling to supply energy to works at very low prices. The supply of electricity in the suburbs is also under consideration, and it is said that two new power stations may be erected at Creil and Laon for this purpose, while the transmission of energy from the coal mines of the Straits of Dover and the northern district is also suggested.—*L'Industrie Electrique.*

La Compagnie Electrique du Nord is erecting a large generating station at Beautor for the supply of energy for lighting and power purposes throughout the Department of Aisne.

GERMANY.—The Thuringische Electricitäts Gesellschaft is a new company which has just been formed with a capital of £300,000 to acquire and carry on the central stations in Thuringia of the Elektrizität Lieferungs Gesellschaft, a concession secured by the A.E.G. for an electric tramway in the town of Gotha and also the generating station in Gotha belonging to the Lahmeyer Gesellschaft.

HUNGARY.—The Neusatzer Electrizitäts Gesellschaft is the name of a new company which has just been in Budapest with a capital of £180,000 to acquire and carry on the electricity supply undertakings in the towns of Neusatz, Peterwardein and Karlowitz.

RUSSIA.—A few months ago attention was directed to the extraordinary conditions which were imposed by the Moscow municipal council in connection with the granting of a concession to a Belgian group for the establishment of electric supply works in the city, in competition with the existing works of the St. Petersburg (1886) Electric Lighting Co. The conditions were so onerous that it was thought likely to be impossible for capital to be raised to carry out the scheme. This has apparently proved to be the case, as the holders of the concession wish to abandon it on the one hand, whilst on the other the City of Moscow is said to desire to be relieved of its obligatious by retaining a portion of the deposit money paid by the concessionaires.

SPAIN.—According to an official announcement, the Compania Barcelonesa de Electricidad, in consequence of being threatened with serious competition, has decided to sell out its assets to the Canadian company, which has lately acquired large waterfalls in the Pyrenees, with the object of supplying Barcelona and its neighbourhood with light and power. The new company, whose style is the Barcelona Traction, Light and Power Co., was lately launched in Toronto with a capital of $4,000,000. The Spanish company was formed in 1895 by the group of the A.E.G., and its shareholders are offered a price of 140 per cent., plus interest, Berlin usance, with accrued dividends up to December 31st. A limited compensation in shares of the Canadian company is also offered. The dividend of the Spanish company in 1911 will probably be the same as that earned in 1910—8 per cent. The ratification by the shareholders of the sale has yet to be made. According to *Electron* negotiations are under weigh not only for the purchase of the Barcelona-Sarria railway, but of other lines in Cataluna, as also of other waterfalls in Tremp and Pallaresa. The capacity of the waterfalls acquired in the Pyrenees is stated to be 120,000 H.P.

Madrid is served by three groups of electric companies, whose mutual relations, according to *Electron*, instead of becoming easier are tending to further complications. These groups are severally, the Hidraulica Santillana, which supplies current to Chamberi and Mediodia; the Salto de Bolarque, which has just entered into a contract to supply current to the Madrilena; and the Hidroelectrica Española which supplies current to the tramways of Madrid, and to its allied company, La Co-operativa Electra de Madrid. The causes of dispute are the prices charged, the last-named company having reduced its charge per KW.-hour to 0·40 peseta and abolished the charge for meters. These charges are considered to be unjustifiable and disastrous to other companies, and to the shareholders of the company itself as well as to those of the Hidroelectrica Española. A breach of compact on the part of the last-named company is alleged by the Salto de Bolarque, and legal opinion has been taken by both parties. In the view of *Electron*, the lamentable deadlock is owing less to the difficulties of the case than the incapacity of those who have directly intervened in the matter.

BELGIUM.—La Société d'Electricité du Nord de la Belgique has completed negotiations for the supply of electrical energy for lighting and power purposes to a dozen small towns and villages in the Malines district, and is in treaty for a number of other municipal contracts. The generating station at Malines, which will be put into operation during the course of the present month, comprises two sets of 3,000 H.P. steam turbines and dynamos.

Dartmouth.—The T.C. has sealed a contract with the Urban Electric Supply Co., Ltd., for the public lighting of the borough for a period of 10 years. The arc lamps are to be superseded by high candle-power metal lamps, and the candle-power of the small incandescent lamps is to be doubled.

Dundee.—At a meeting of the Electricity Committee of the T.C. last week, the electrical engineer—Mr. Harry Richardson—advised that a new sub-station be erected in Dock Street at an estimated cost of £7,200. The engineer explained that the proposal was really a necessity, as the load at present was so heavy that they had both turbines working, and the machinery in the old station was also running hard. He was of opinion that the proposed sub-station would feed the most congested area of the city, and would more than pay for itself in preventing the loss in distribution. In reply to a question, the engineer stated that when the new station at the Stannergate was opened he did not anticipate that a sub-station such as that proposed would be required for two years yet, but the demand for current had far exceeded his expectations. He also hinted that, at the present rate of progress, an extension of the new station would also be necessary soon. The matter was remitted to a Committee for consideration and report.

Dunoon.—The B. of T. has been in communication with the T.C. regarding the fulfilling of its obligations in connection with the electric lighting provisional order of 1906. The T.C. has already received three extensions of time.

Ealing.—At the last meeting of the Council, the district auditor roported that the net profit on the undertaking for the past year amounted to £1,665, as against £2,005 for the preceding year; this showed a decrease of £340. Owing to the large number of new consumers, the sales of current continue to increase in the aggregate. The total of loans raised amounts to £144,594.

Edinburgh.—A meeting with a view to promoting an electrical exhibition was held on January 12th. Mr. G. W. Crawford pointed out the desirability of holding the exhibition in view of a probable gas exhibition in the city. It was finally agreed that it was desirable to hold such an exhibition, and a Committee was appointed to inquire into the financial support which may be forthcoming.

The Corporation Electric Lighting Committee has purchased sufficient coal to meet the requirements of the undertaking until May 15th. The supply has been augmented owing to the possibility of a miners' strike, and partly owing to the fact that the condensing plant has not been completed.

Gellygaer.—The U.D.C. has declined to allow the Rhymney Valley Electric Supply Co. to use overhead wires for the purpose of supplying current to Gilfach, Church Place and Heolddu, where there are many applications for current. The Council demands the use of underground cables.

Goole.—In regard to the proposed electric lighting schemes for Goole, which have been suggested at the instance of the Electrical Distribution of Yorkshire, Ltd., and Mr. James W. Speight, the members of the U.D.C. were hurriedly called together on Monday—the last day for lodging objections—and decided to lodge objections with the B. of T.

Gravesend.—The T.C. has now decided to support the Bill of the I.M.E.A., and to contribute up to £10 towards the cost.

As the result of arbitration, current is to be supplied by the T.C. to the Tramway Co. for seven years from August 7th, 1910, at 2d. per unit up to 180,000 units a year; 1·3d. per unit between 180,000 and 280,000 units; and ·8d. per unit beyond. These rates are subject to agreed coal clauses.

Harrogate.—Further extensions are to be made in lighting the streets with electricity.

Hazelgrove and Bramall.—The U.D.C. has decided not to assent to the application of the Stockport T.C. for permission to supply current to the owner of the Woodlands Estate, Offerton. A committee has been appointed to consider the advisability of the Council obtaining its own provisional order.

Heckmondwike.—The L.G.B. is to be asked for an answer to the application of the U.D.C. for sanction to borrow over £20,000 on the electricity account, in regard to which an inquiry was held in May last. Most of the money has been spent, but the Council has decided that other pressing work must remain in abeyance pending the Board's decision.

Knaresborough.—The R.D.C. has assented to the Harrogate T.C. laying electric cables in the district on the payment of 1s. per annum in respect of each highway utilised for the purpose.

Launceston.—At a meeting of the T.C. recently, Mr. J. H. B. Prouse asked what steps had been taken to carry into effect the resolution passed at the last meeting to procure an estimate of the cost of electric light installations at the Guildhall, Town Hall, and Public Library. Dr. Thompson, chairman of the Launceston Gas Co., thought they should also ask for an estimate for lighting these buildings by incandescent gas in place of the antiquated gas burners now used. The Corporation settled the matter by inviting suggestions for the better lighting of the public buildings of the borough.

Leeds.—The Micklefield Coal Co. is opening new pits at Kippax, near Leeds, which have certain points of interest, in that the terms of the lease stipulate that no chimney shaft will be permitted after the sinkings are completed, and also provide for an ornamental winding house, and the planting of the dump with trees and shrubs, &c. In order to comply with these requirements, electrical power is being largely used, the supply being obtained from the Yorkshire Power Co. through a local sub-station, and fed at 2,000 volts to a Lahmeyer rotary-converter set with a 10-ton fly-wheel, which in turn supplies two 400-H.P. 200-volt motors direct-coupled to an 11-ft. winding drum. The whole of the haulages are to be driven by compressed air, the compressor, and presumably pit pumping, being electrically operated. A second pit and winder are also to be erected near the first one, but the whole of the output will be taken about 2½ miles to screens at another of the company's pits, in order to safeguard the beauty of the neighbourhood, which is residential in character.

Liverpool.—In view of the recent controversy on the Corporation electricity supply, it is interesting to note that the report of the electrical engineer upon the supply for 11 months to the date of the report, shows a considerable increase in the use of current for power. The units supplied from January 1st, 1911, to November 30th, for lighting were 8,279,473, an increase of 1·35 per cent. on the corresponding months in 1910; for traction,

20,575,097, an increase of 1·442 per cent.; and for power, 4,821,019, against 3,701,821, an increase of 30·234 per cent. The total number of units supplied during the period was 33,675,589, compared with 32,150,416 for the eleven months of 1910.

London.—HAMPSTEAD.—At the meeting of the B.C. on January 11th a letter was received from Mr. G. H. Cottam resigning his position as chief electrical engineer. The Lighting Committee recommended that the resignation be accepted, and the engagement terminate on July 12th. An amendment that the engagement terminite in three months was defeated by 22 votes to 10, and the Committee's recommendation was then agreed to. The Lighting Committee further recommended that the question of granting a superannuation allowance to Mr. Cottam be referred to the Finance Committee. After discussion it was resolved that the further consideration of the matter be postponed for three months, or until the L.G.B. inquiry into the lighting expenditure. The Lighting Committee further reported that it had considered a letter from Mr. E. Sayer, expressing surprise at being summarily dismissed from his position as chief assistant electrical engineer without having any opportunity of defending himself before the Council, and asking to be paid three months' salary in lieu of notice. It was decided to repudiate liability for the payment of the salary.

MARYLEBONE.—£2,650 is to be borrowed from the L.C.C. for the period of 12 years for storage batteries for the electricity undertaking.

BERMONDSEY.—Sanctions have been received from the L.C.C. to the erection of (1) an addition to the boiler house at the electricity works, and (2) for an extension of the existing condenser plant. Such consents, however, do not include any sanction to the Borough Council's proposed loan, sanction for which was refused by the County Council in November last.

Lowestoft.—At the last meeting of the Council the auditor's report on the electricity undertaking was adopted, which showed a net surplus for the year of £99. £854 has been debited to the revenue account for the purpose of redeeming loans, and £3,723 has been spent on capital account, and for part of this amount no sanction has been received from the L.G.B., but application had been made for sanction to cover this capital expenditure.

Lytham.—In reply to the representatives on the matter, the U.D.C. has been informed by the B. of T. that in view of the efforts being made by the Lytham Electric Light and Power Co., Ltd., to proceed with the scheme for electric lighting, the department had for the present decided to defer the revoking of the provisional order.

Marazion (Cornwall).—An electricity scheme for the parish is under contemplation beween the P.C. and the Cornwall Electric Power Co.

New Zealand.—A New Zealand municipality has under consideration a scheme for the installation of electrical power plant for tramway working, house and street lighting, drainage and water works pumping, and general industrial uses. It is proposed to equip the station with Diesel oil engines. The proposal involves the flotation of a loan of about £11,000; particulars may be obtained by British manufacturers on application to the Commercial Intelligence Branch of the B. of T.

Newport (Fife).—At a meeting of the Town Council last week a motion was put forward by one of the members that electricity for lighting and power purposes be supplied throughout the burgh, and that a committee be appointed to ascertain the terms upon which a supply could be obtained from Dundee, and alternatively, the cost of the erection and maintenance of a generating station in the burgh. It was also suggested that information might be obtained as to the terms upon which the Tayside Electric and Gaslight Co.'s undertaking could be acquired. The motion, on being put to the meeting, was defeated by six votes to three.

North Cray.—The Bromley (Kent) R.D.C. has consented to the order being applied for by Bexley U.D.C. to enable the latter to supply current to the parish of North Cray.

Nuneaton.—The T.C. has applied to the L.G.B. for a loan of £1,850, for a feeder and feeder booster needed in connection with a supply of current to the Griff Granite Quarry.

Oldham.—The General Committee of the Equitable Co-operative Society has decided that the Society should cease to generate its electricity and that in future the supply should be obtained from the Corporation. It is found that the plant is not capable of supplying energy as economically as it can be purchased from the Corporation.

Paisley.—The manner in which the recent arrangement come to between the Corporation and the tramway company is working—whereby a flat rate was fixed for current—may be judged by the electrical engineer's monthly report. From November 17th to December 16th the electric current supplied to the Paisley District Tramways was 112,788 units at ·975d., which raises the current consumed from May 17th to December 16th to 834,788 units at £2,958. Over the corresponding period of the previous year the current consumed was greater by 44,541 units, but the income had fallen off by £865.

Rhyl.—The Council has decided to apply for a loan of £500 for additional electric service required at the Marine Lake in connection with various enterprises to be introduced by the Rhyl Amusement Co., Ltd. Special terms for lighting and power have been arranged between the Council and the company.

Sherborne.—The U.D.C. has passed a resolution consenting to the application for a prov. order for E.L. by Messrs. J. & W. Purves, of Exeter, who undertake to supply current for public lighting at not more than 3d. per unit.

Sidmouth.—A meeting of ratepayers was held on Friday last to discuss the question of the proposed purchase of the Sidmouth Gas and Electricity Co. by the Urban District Council. Mr. T. Kennet-Were presided, and explained to a large assembly the steps which had been taken in the matter. A resolution approving steps to enable the Council to acquire the undertaking of the company was carried by a large majority.

Skegness.—The U.D.C. is in communication with several experts who have offered their services as consulting engineers in connection with the proposed electric lighting scheme.

Southampton.—The electrical engineer has reported that the receipts of the electricity undertaking show an increase for the half-year ended September 30th last of nearly £2,700 over the corresponding period of last year, while the estimated increase up to March 31st, 1912, was put at £2,837. Thus there was every reason to anticipate that at the end of the present year the income would be some £5,000 or £6,000 more than what it was in the previous 12 months; 25 per cent. more units were sold than for the same period 12 months ago, and the returns for the current half-year indicated a still greater increase. On the suggestion of the engineer, it has been decided to apply to the L.G.B. for sanction to borrow £9,600, the estimated cost of providing additional plant for next winter's load. Such plant is to be the exact duplicate of that last installed. Application is also to be made to borrow £2,000 for motors, £1,000 for radiators, £3,500 for services, and £1,500 for meters.

Swindon.—The T.C. has received the sanction of the L.G.B. to loans of £1,600, £1,500 and £410 for electricity purposes.

Teignmouth.—The U.D.C. has referred to a committee of the whole Council the question of applying for a prov. order for E.L.

West Hartlepool.—At a meeting of the T.C. on the 9th inst., the Electricity Committee reported the receipt of a letter from the I.M.E.A. asking for a contribution towards the expense of promoting a Bill to amend the Act relating to electric lighting. Ald. MacFarlane (chairman of the Committee) said the Committee had decided to take no action. Ald. Robson, who said he was speaking for the majority of the Committee, said the object of the Association was to obtain powers to enter into a retail trade in competition with tradesmen in the sale of various fittings for houses. For that reason alone the Committee decided not to support the Bill. Ald. MacFarlane said all the Bill proposed to do was to put municipalities in the same position as gas companies. After further discussion the minute was sent back to the Committee.

Whitehaven.—The T.C. has again deferred consideration of a scheme for assisted wiring, submitted by the electrical engineer.

Mr. Thos. Richardson, M.P., has informed the T.C. that he will support in Parliament the Bill of the I.M.E.A. seeking wiring powers for local authorities.

Widnes.—The T.C. on January 9th signed an agreement with the Mersey Power Co. for a supply of electricity. The necessary connections with the power station are being made, and the supply will shortly be available.

Winchester.—The T.C. has adopted a schedule of wiring prices on the deferred payment system.

TRAMWAY and RAILWAY NOTES.

Aberdeen.—The T.C. has, by 29 votes to 4, adopted the recommendation of the Tramways Committee for a system of railless traction for the Footdee district, the route to be from Market Street, along the quays to the east end of York Street. It was agreed that a communication be addressed to the Harbour Commissioners for consent to application being made for the requisite powers to carry out the scheme.

Argentina.—The Paraná Municipality has granted a concession for an electric tramway to a company represented by Dr. Juan V. Garcia. The concession is for 90 years, after which it will pass over to Corporation.

Ashton.—Further trouble is threatened by the employés of the three tramway authorities running into Ashton-under-Lyne. Some time ago Mr. Ernest Moon, K.C., representing the B. of T., sat as arbitrator, and his award appeared to give satisfaction. After a few weeks' trial the men are dissatisfied. They complain that each of the three authorities is carrying out the terms of the award differently; that the conditions generally are not in the spirit of the award; and that they do not get the full period allowed for meal times. They are desirous of another visit by Mr. Moon, and are threatening to strike.

Belfast.—The revenue account of the tramways department for the nine months ended December 31st last, shows a balance at credit of net revenue of £30,157. The general manager's recommendation that in view of the satisfactory state of the finances, £13,000 be appropriated and placed to the credit of the depreciation account and invested, has been adopted by the Committee. One hundred motormen have won the annual bonus for careful driving and freedom from avoidable accidents during the past year, and of that number 14 had gained special commendation. One hundred and twenty-six conductors received the bonus for accuracy in their cash and daily accounts during the same period, 43 of these being commended for special accuracy. It is advised by Mr. Nance—and the Committee has under consideration the proposal—that a system of profit-sharing be adopted under which the tramway staff will benefit each year to the extent of 10 per cent. of the amount of the excess of revenue over expenditure.

Bradford.—The first accident to happen in connection with the new railless trolley system of the Corporation occurred last week on the route between Dudley Hill and Laisterdyke, when, as the result of the trolley leaving the overhead wires, the car, which was going down-hill, swerved heavily and smashed through a wall into a field. The steering gear was severely damaged, and the conductor was injured and removed to the infirmary.

Brighton.—At the public meeting convened to consider the proposed Parliamentary Bill for railless traction powers, the voting resulted in a majority of 6 in favour, and a written demand for a poll of the town has been put in by opposers of the scheme.

Continental Notes.—FRANCE.—It is recognised that an improvement in the traffic at the Saint Lazare Station, Paris, can only be effected by electrifying the suburban railways, a matter which has been under consideration for a long time; but, according to *l'Industrie Electrique*, the Minister of Public Works has suddenly given orders to suspend the preparation of a scheme of this nature. The Orleans Co. is contemplating the electrification of the line to Sceaux, on which the steam trains give rise to foul fumes in the Luxembourg tunnel, and has sent an engineer to the United States to study the work that has been carried out there. Our contemporary fears that the result will be the placing of large orders abroad, although French engineers are perfectly competent to do the work.

AUSTRIA.—The Istrianer Electricitäts und Kleinbahn Gesellschaft has secured a preliminary concession for the construction and working of an electric tramway in the town of Pola.

ITALY.—The Consiglio Superiore dei Lavori Pubblici have acceded to the applications for the following concessions:—For the construction of an electric tramway between Lucca, Camaiore and Pietrasanta, with Government subsidy; for an electric tramway line connecting Milan, Balsamo and Cinisello, with a branch to Sesto San Giovanni; an electric tramway line from Velletri to Genzano, for which the Società delle Tramvie e Ferrovie di Roma are applicants; and the establishment of an electric tramway service in Modena.—*Giornale dei Lavori Pubblici.*

GERMANY.—The electric express railway projected between Cologne and Düsseldorf appears to be approaching realisation. The track has been decided upon. The railway is purely a municipal line, to serve the passenger traffic between the two cities named. It is designed solely to serve the purpose of speedy transit. At first a 20-minute service will be established, which is intended to be increased later to a 10-minute service. With regard to the Cologne section, it will be carried out by Rhine firms. The course chosen is the left Rhine bank, the river near Düsseldorf being crossed by substantial bridges. The track is to be 35·4 km. long, exclusive of 4·7 km. within the purlieus of Cologne and Düsseldorf.—*Elektrotechnik und Maschinenbau.*

SWITZERLAND.—The energy required for the electric working of the Gotthard Railway will, according to the scheme of Engineer Kummer, with a 30 per cent. increase of traffic over 1907, be supplied by three generating stations, namely, the Amsteg (20,000 KW.); the Göschenen (13,000 KW.); and that on Lake Rittom (30,000 KW.). The total cost of the undertaking in this case will amount to £2,480,000. Working costs should come out at 30 per cent. lower than steam.—*Zeitschrift für das gesamte Turbinenwesen.*

Crewe.—The question of introducing the railless traction system is engaging the attention of the Corporation. It is suggested that there should be four miles of route with a quarter hourly service; the first cost would work out at about £1,500 to £1,600 per mile.

Doncaster.—By 6 votes to 4 the Tramways Committee has decided that the extended tramway to Brodsworth shall be on sleeper track in preference to adopting the railless trolley system.

The Committee has resolved that application be made for an order to extend the tramway from Balby to Warmsworth, so as to link up the town with the Edlington colliery village.

Dundee.—The working of the tramway parcel traffic between the city and Broughty Ferry has been considered by the Corporation Tramways Committee, Mr. Fisher, the manager, giving it as his opinion that it would be to the interest of the Department to extend its business as parcel carriers. A sub-Committee was appointed.

East London Railway.—The half-yearly report of this company refers to the preliminary work and financial arrangements in connection with the electrification of this railway; specifications, plans, &c., have been completed for both electric traction and automatic signalling.

Edinburgh.—The burgh engineer is to confer with the engineer of the Tramways Co. with a view to fitting up a car with a new type of life-guard. A Sub-Committee of the Council Tramways Committee is to meet representatives of Leith T.C. regarding the adoption of railless traction instead of tramway extensions. The Tramways Committee has considered the possibility of running double-decked cars to the terminus at Gorgie; a railway bridge, it appeared, presented a difficulty, and the town clerk is to communicate with the Railway Co. and the Tramways Co. on the matter.

Fife.—The Fife Electric Power Co. having taken over the Wemyss Tramway Co., Ltd., numerous changes are to take place in the staff of the company at Methil. The manager is to be retained, but the others have received notice terminating their engagements.

Jarrow-on-Tyne.—At a meeting of the T.C. on the 11th inst. a letter was read from the B. of T. in reference to a communication from the Council as to the proposed transfer of the Jarrow and South Shields Light Railway Order, 1901, to the Jarrow and District Electric Traction Co., Ltd. The letter stated that the Board was not aware that there was anything in the position of the purchasing company which would justify the Board in refusing to consent to the transfer, and, in the absence of any specific objection from the Corporation, the Board proposed to sanction the transfer of the undertaking.

Leeds.—The trials of weather screens on the tramcars have proved satisfactory. During the recent period of bad weather comparisons were made on screened and unscreened cars travelling over the severest route on the Leeds system. When the proposal was first mooted a great majority of the drivers were opposed to it, holding the view that a screen would impede clear vision. On the dozen or so cars on trial, however, the screen is fitted with an adjustable shutter in the front panel which overcomes this objection. The screens have been manufactured at the tramway workshops, and the Tramways Committee is shortly to discuss the advisability of fitting screens to all cars in use on exposed routes.

Lowestoft.—At the last meeting of the Council the Tramways Committee reported an increase of £1,040 in receipts to date, as compared with the corresponding period of last year.

Nuneaton.—The T.C. has under consideration the question of a tramway installation for the borough, and an inspection has been made of the railless traction system at Leeds. The matter is to be fully gone into at the February meeting of the Council.

Paisley.—The Sub-Committee on By-Laws of the Town Council has been in negotiation with Mr. Coutts, the general manager of the Paisley District Tramways, with reference to the question of overcrowding and lack of ventilation on the company's cars. Mr. Coutts explained that the main congestion was on the Paisley and Renfrew section, and that it was impracticable to provide an additional service during the hours when the pressure of workmen's cars was on, as not only was there a difficulty regarding plant, but the lines, as laid, would not carry more cars without additional feeders. He also objected to the provision of larger cars on the ground that these would necessitate the laying of heavier rails, and the use of trailers he considered dangerous. As to improved ventilation, Mr. Coutts stated that the cars were being fitted with ventilators of a different type.

Ramsbottom.—The proposal of the Council to promote a Bill in Parliament for the provision of a system of railless traction in Ramsbottom, was explained and considered at a public meeting of townspeople, on January 10th. Councillor Stockdale said it was proposed to run railless cars by overhead equipment from Holcombe Brook to Edenfield, along 3¼ miles of road, and powers of extension would be secured. There would be a half-hourly service, and the estimated cost of the scheme was £9,250. The half-hourly service and the proposed route were criticised, but eventually a resolution was carried approving the scheme.

Stalybridge.—With reference with work being carried out in Stalybridge by the Joint Board, the Highways Committee of the T.C. recommended that the Board should be informed that the provisions of the Tramways Acts and the Electric Lighting Acts, with reference to the giving of notices prior to the commencement of any further works, must be complied with. Councillor Bottomley, at the meeting of the Stalybridge Council, said the Board, he believed, had always advertised in the local papers when it had been its intention to do work of that kind, and he thought that it had thereby done all that was necessary to comply with the Act of Parliament.

Swinton and Pendlebury.—On the minutes of the Tramways and Electricity Committee coming up for adoption at the meeting of the Council, several members expressed dissatisfaction with the single-deck electric cars which the Salford Corporation is now running over the local route. It was decided that the clerk write to the Corporation requesting the withdrawal of the cars from the local service on the ground of their being dangerous.

Twickenham.—The Highways Committee has decided to prepare a petition against the Southall, Hounslow and Twickenham Railless Traction Bill, on the ground that there were several portions of Whitton Road unsuitable for railless traction unless widenings were effected; also that the protection clauses of the Bill required strengthening materially. When satisfactory clauses are obtained the petition will be withdrawn.

Venezuela.—A concession has been granted for the construction of a railway from either the Orinoco or the Caroni to El Callao. Four years are allowed for carrying out the work. Under the terms of the agreement the concessionaire may utilise the waters of the Rivers Caroni and Cano del Toro with the object of generating electric power for railways, tramways and other industrial purposes.—*Board of Trade Journal.*

York.—The Tramways Committee has under consideration the possibility of utilising railless cars in connection with an extension to Heworth. The laying of tramways down Bootham, and by means of a bridge over the Ouse near Clifton, extending the system to the Leeman Road area, is also to be discussed.

TELEGRAPH and TELEPHONE NOTES.

Australia.—It is reported in the *Australian Mining Standard* that in view of the litigation between the Marconi Co. and Messrs. Siemens Bros. & Co., regarding wireless telegraph patents, and the great delay which has already been incurred in the establishment of wireless stations round the coast of Australia, the Commonwealth Government has decided to proceed with the work, using a system recommended by Mr. Balsillie, the Government wireless expert. If infringement of existing patents is proved, the Government will pay for it. Under the present circumstances the Government cannot take the responsibility of adopting either of the contending companies' systems. Four stations will be erected at once.

Communication with Australia.—A return showing the progress of Press cable communication between London and Australia during recent years, by way of the Pacific and the Eastern Extension Company's lines, states that the number of Press words received *via* Pacific for the year ended December 31st, 1909, was 21,635, and for the year ended September 30th, 1911, 463,726. (It was in 1909 that the Press rates were reduced.) The number received *via* Eastern for the first period was 218,467, and for the second 220,214.—*Australian Mining Standard.*

Telegraph Mechanicians.—At a meeting of the Nottingham Branch of the P.O. Telegraph Mechanicians' Association a resolution was carried protesting against the Postmaster-General's reclassification scheme, whereby it was alleged the work of highly-skilled mechanics had been depreciated and put upon a scale of pay far below its commercial value.

United States.—Recently it was announced that the Postmaster-General would recommend the Government to purchase the telegraph systems of the United States and work them as part of the postal service; the cost of the purchase was estimated at 100 millions sterling. It appears, however, that little importance can be attached to the statement. A proposal to purchase the Canadian telegraph and telephone systems will shortly be made in the Dominion Parliament; at present the rates charged by the companies are very uneven.

Uruguay.—The Government has issued a decree making it obligatory that all passenger vessels trading with Uruguayan ports shall be provided with wireless installations before May 1st.

The Government is reported to be taking active measures for placing the telephone wires underground, and at the same time adopting the automatic system for exchanges.—*Review of the River Plate.*

Wireless in Warfare.—A writer in the *Times* of January 6th gives some particulars of the wireless telegraph equipments used by the Italian army of occupation in Tripoli. At the commencement of the war Italy possessed about a dozen wireless field stations, mostly Marconi 1½-KW. sets, which can work over 100 miles and can be erected in 20 minutes. The equipment, including carts and *personnel*, weighs in all under 60 cwt. Changes in wave length are effected by the movement of one handle; the transmitter is not sharply tuned, but the receiver is capable of very sharp tuning. Secrecy is secured by frequent changes of wave length and the use of different codes

Wireless Telegraph Conference.—It is stated that the next International Conference for wireless telegraphy will take place in London on June 4th, when representatives of all Governments which are parties to the Berlin Convention will be present. The total number of wireless stations throughout the world is computed at 1,100, of which 869 are on merchant vessels. Of the latter, Great Britain is credited with 305, the United States with 205, Germany with 143, Italy with 51, Holland with 35, and France with 31.

Wireless Telegraphy.—On January 11th, says the *Times*, the Cross Sands Lighthouse, near Yarmouth, reported by wireless telegraphy that the German brigantine *Falke* had stranded on the sands during a fog. In reply to the message the Caister lifeboat was sent out and rescued the crew.

According to an American Consular report, the Mexican Government announces the early establishment of a series of wireless telegraph stations along the coast of Lower California.

Wireless Telephony.—The outcome of the complaint made by Mr. Grindell-Matthews, at the end of September, that during a demonstration of his wireless telephone system at the War Office, experts attached to the War Office took notes and made sketches of the apparatus without permission, and contrary to agreement, is that on January 10th the inventor addressed a letter of apology to the War Office, and completely withdrew the charges which had been made and published in the Press.

CONTRACTS OPEN and CLOSED.

OPEN.

Ashton-under-Lyne.—January 24th. Three Lancashire boilers and two 1,500-KW. turbo-alternators, for the Corporation. See "Official Notices" January 5th.

Australia.—N.S.W. GOVERNMENT RAILWAYS.—January 22nd.—Supply and erection at the White Bay power house, Sydney, of eight water-tube boilers, with superheaters, economisers and mechanical stokers. January 29th.—A 25-KW. booster set. Particulars, Electrical Engineer's Office, 61, Hunter Street, Sydney.

February 7th.—The Prahran and Malvern Tramways Trust, Melbourne, are inviting tenders for 1,272 tons of tramway rails. Specifications and forms of tender, £2 2s. (returnable), from J. Coates & Co., Ltd., Suffolk House, Laurence Pountney Hill, London, E.C.

February 19th.—Wire-testing machine, for the Postmaster-General's Department in Tasmania. See "Official Notices" January 5th.

MELBOURNE.—March 5th. Telephone material (Sch. 612). March 12th.—Instruments (Sch. 639); for Deputy P.M.G., Melbourne.

Austria.—KIRCHBICHL.—January 27th. Tenders are invited for the supply of an electrically-driven winding engine and other mining machinery. Particulars, K. K. Bergverwaltung in Kirchbichl.

Belgium.—January 29th. The municipal authorities of Vaux-sous-Chevremont (Liége) are inviting tenders for the establishment of a central electric lighting station in the town.

March 1st.—The Belgian Direction Générale des Ponts et Chaussées in Brussels (38, Rue de Louvain) are inviting tenders for the supply and erection of a 40-ton electric crane at the port of Ostend.

Belgrade.—January 17th and 22nd. The Servian State Railway Department requires tenders for the supply of 1,400 oak railway sleepers and oak telegraph poles.

Bulgaria.—January 29th. The municipal authorities of Phillipopolis are inviting tenders for the concession for the electric lighting of the town.

Burnley.—Lighting battery for the Workhouse, for the Guardians. See "Official Notices" January 5th.

Burton-on-Trent.—January 27th. One 1,250-KW. turbo-alternator, and other electrical and steam plant for the Corporation. See "Official Notices" January 12th.

Cheltenham.—January 23rd. Electric light fittings, for a year, for the T.C. J. S. Pickering, borough engineer.

Croydon.—January 29th. Mixed-pressure turbine plant, for the Corporation. See "Official Notices" January 5th.

Dartford.—January 23rd. One high-speed vertical uniflow engine, tandem generators and three-wire balancer, three superheaters and extensions to pipework, switchboard and electrically-driven centrifugal pump, for the U.D.C. See "Official Notices" December 15th.

Dublin.—January 30th. Dublin Port and Docks Board. Two 4-ton electric portal wharf cranes. Specification, £1 returnable, from Sir J. P. Griffith, Engineer to the Board, East Wall, Dublin.

Exeter.—February 2nd. Vulcanised rubber cables, distribution fuseboards, distribution switch and fuseboard, steel conduits and fittings, for the Visiting Committee of the Asylum. See "Official Notices" January 12th.

Halifax.—February 5th. Stores and materials for a year, for the Corporation Electricity Department. See "Official Notices" January 12th.

February 12th.—Stores and materials required by Tramways Department during year ending March 31st, 1913. Forms of tender, &c., obtainable from Tramways Engineer, Tramway Offices, Skircoat Road.

(*Continued on page* 105.)

A BATTERY SUB-STATION PLANT AT HUCKNALL COLLIERY.

By G. C. ALLINGHAM.

THE employment of three-phase current in mining, and especially in colliery work, has become so well-nigh universal of late years, that many people have come to look upon it as the only system worthy of consideration for such purposes. It may therefore be useful to point out that there is still a field in mining work for the older direct-current system, which presents important advantages in certain cases.

As an example of direct-current power distribution in a colliery, combined with three-phase transmission, the following description of the electrical plant at the Hucknall Colliery may be of interest.

FIG. 1.—BATTERY ROOM, NO. 1 PIT.

The Hucknall Colliery possesses two pits, which are situated about 1¼ miles apart, at opposite sides of the town of Hucknall Torkard, which lies between Nottingham and Mansfield.

At one of these pits, known as No. 2 Pit, an exhaust steam turbo-alternator set was put down some years ago for the purpose of supplying power to some underground haulage gears in that pit. This set is run by the exhaust steam from the winding engine, of which there is an ample supply, and consists of a turbine of the Rateau type direct coupled to a three-phase two-pole alternator having a rated output of 110 KW. with a power-factor of 0·85 at 500 volts between phases; the periodicity is 50 and the speed 3,000 revs. per min. This set is illustrated in fig. 3.

This plant, although a comparatively small one, is of interest as being the earliest instance of the employment of an exhaust steam turbine in a colliery in this country. A full description of the plant was given in a paper read by Mr. W. Maurice before the Institution of Mining Engineers in 1906.

At the other pit, known as No. 1 Pit, the only electrical plant installed until recently consisted of a small Robey single-cylinder vertical engine belted to a D.C. dynamo having an output of 80 amperes at 400 volts, which supplied one coal-cutter underground, besides lighting the offices, workshops and other buildings on the pit-bank. Within

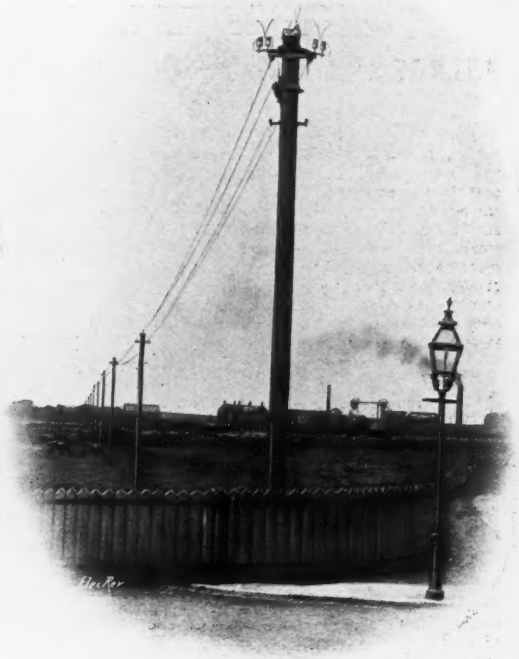


FIG. 2.—OVERHEAD TRANSMISSION LINE, HUCKNALL COLLIERY.

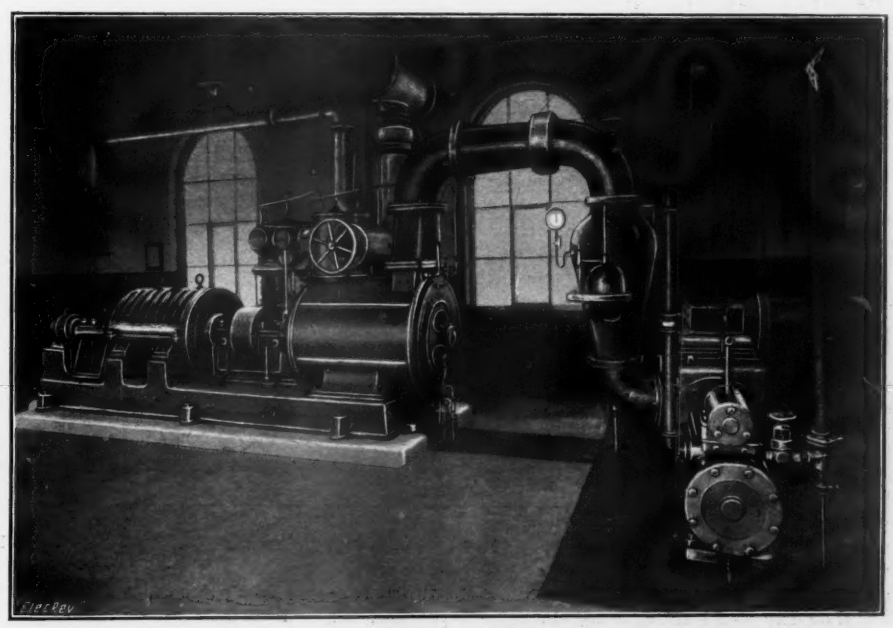


FIG. 3.—EXHAUST TURBO-GENERATOR SET, POWER STATION, NO. 2 PIT.

the last few years, however, the workings at No. 1 Pit have been considerably developed, with the result that a greatly increased supply of power was required for driving additional coal-cutters, a small underground haulage, a new screening plant, workshops, a sawmill, &c.

Instead of putting down a new generating plant at No. 1 Pit, it was decided to utilise the spare power available at

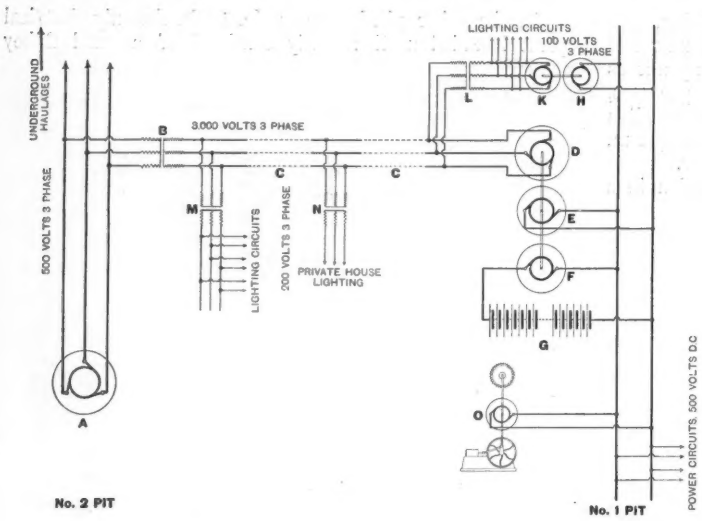


Fig. 4.—General Connections of Battery and Turbine Plant.

No. 2 Pit (where the exhaust turbo set was running on a very poor load-factor) for supplying the requirements of No. 1 Pit also.

At first sight, the obvious method of doing this would have been to distribute the three-phase supply from the generator at No. 2 Pit direct to three-phase motors at No. 1 Pit. There were, however, two objections to this course. Firstly, the power demand, both of the haulages at No. 2 Pit and of the coal-cutters, sawmill, &c., at No. 1 Pit, fluctuates heavily and rapidly, and it would have been absolutely impossible for the exhaust turbo set to have taken the overloads unaided, especially as the power factor would have been very low on the peak loads. Secondly, the winding engine at No. 2 Pit only works 16 hours a day and five days a week, and sometimes even less when the pit is not working full time, whereas power is being consumed at No. 1 Pit throughout the 24 hours, and also during the week-ends; so that, unless some means of storage had been provided, the exhaust turbine would have had to run more than twice the number of hours per week, and during the additional hours it would have been running very uneconomically on live steam reduced to atmospheric pressure, for the set was put in before the days of mixed-pressure turbines.

The only possible method of overcoming these difficulties was to provide means for storing and equalising the power supply, and this was effected by converting the power received at No. 1 Pit to direct current, and working in conjunction with a storage battery.

An additional argument for the employment of direct current at No. 1 Pit, was that the management of the colliery greatly preferred direct-current coal-cutters to three-phase ones, which have an inferior starting torque and take much heavier starting currents.

In order to transmit the power to No. 1 Pit, a 90-kw. transformer has been put down at No. 2 Pit, which steps up the voltage from 500 to 3,000 volts, at which latter pressure energy is transmitted by a bare overhead line (fig. 2) to No. 1 Pit, where a converting set has been installed, consisting of an 80-k.v.a. 3,000-volt synchronous motor, direct coupled to a 500-volt 100-ampere compound-wound d.c. generator, an automatic reversible booster for regulating the working of the battery being also coupled on the same shaft. This motor-generator-booster set was built by the Lancashire Dynamo & Motor Co., Ltd., and is shown in fig. 5.

The battery, which is illustrated in fig. 1, consists of 240 Tudor cells, type H. Q. 9, capable of giving discharges of 110 amperes for 3 hours, 236 amperes for 1 hour, or 400 amperes momentarily. The cells contain nine plates each, but are mounted in glass boxes of sufficient size to contain 13 plates, thus rendering it possible for the capacity of the battery to be increased by 50 per cent. in the future, if required, by filling up the boxes with additional plates.

The general arrangement of the plant is shown diagrammatically in fig. 4, where A is the three-phase turbo-generator at No. 2 pit, B the step-up transformer, C the overhead line, and D, E, F the converting set in the sub-station at No. 1 Pit.

The 3,000-volt synchronous motor D normally takes power direct from the overhead line, and drives the d.c. generator E and the booster F; E supplies the power load at No. 1 Pit and at the same time charges the battery G through the booster F.

The three-phase haulage load at No. 2 Pit, which is supplied direct from the alternator A, fluctuates very heavily, and whenever this haulage load increases, the motor-generator D, E, F tends to drop its load, and the charging current supplied to the battery falls off. Thus the motor-generator

Fig. 5.—Switchboard and Motor-Generator-Booster Set, No. 1 Pit, Hucknall Colliery.

set acts as a buffer, and steadies the load on the alternator to a considerable extent; at the same time, it also tends to compensate automatically for the drop in power factor on heavy haulage peak-loads, with the result that the voltage regulation of the alternator is greatly improved while the motor-generator is running. On very heavy haulage peak-loads, the motor-generator actually reverses, taking current from the battery and supplying power back to the generating station to assist the alternator A.

All fluctuations in the D.C. power load at No. 1 Pit are in the meantime taken care of by the automatic reversible booster F and battery G, so that they do not affect the output of the D.C. generator E, nor disturb the three-phase supply in any way.

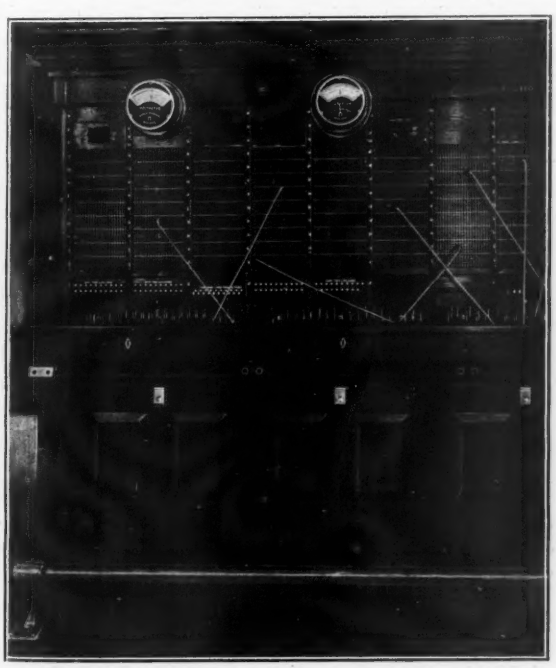
The way in which the plant works may be summarised briefly as follows. The generating set A supplies power direct to the three-phase motors at No. 2 Pit, and any surplus there may be is delivered to the motor-generator set at No. 1 Pit; this in its turn supplies power direct to the D.C. motors at No. 1 Pit, and any surplus is stored in the battery; when momentary peak-loads occur, the battery discharges, and assists both the D.C. converter and the A.C. generator. When the generating plant is shut down, the battery takes the power load at No. 1 Pit, and also supplies the lighting load through a small motor-alternator H K, consisting of a 500-volt motor H direct-coupled to a 100-volt three-phase generator K, which has an output of 5 KW., and is coupled to the A.C. line through the 100/3,000-volt transformer L.

FIG. 1.—TEST ROOM AT THE NEW "AVENUE" TELEPHONE EXCHANGE (page 102).

The lights at No. 2 Pit are supplied at 200 volts through the 3,000/200-volt transformer M. The overhead line is tapped at about its centre to light two private houses through the step-down transformer N. The lights at No. 1 Pit-bank and in the adjoining offices and private houses are supplied at 100 volts three-phase, as shown in the diagram. When generator A is running, these lights are supplied through the transformer L, which steps down; and when A is shut down, they are supplied direct by the small motor-generator H K, which also supplies the lights at M and N through the transformer L, which then steps up.

One of the D.C. motors at No. 1 Pit, which is usually employed for driving the sawmill, is arranged so that it can, if required, be belted to a steam engine, which is kept in reserve for the purpose, and run as a generator, when it is capable of giving an output of 50 amperes at 500 volts. This machine, which is shown at O on the diagram, is available as a stand-by for maintaining the D.C. supply at No. 1 Pit, in conjunction with the battery, in case of any interruption or stoppage of the three-phase supply from No. 2 Pit.

The whole plant is remarkably flexible in working, and forms an interesting example of the utilisation of waste power and of the equalisation of a mixed three-phase and direct-current load by the employment of a storage battery.



IG. 2.—TESTING POSITIONS AT END OF JUNCTION SWITCHBOARD.

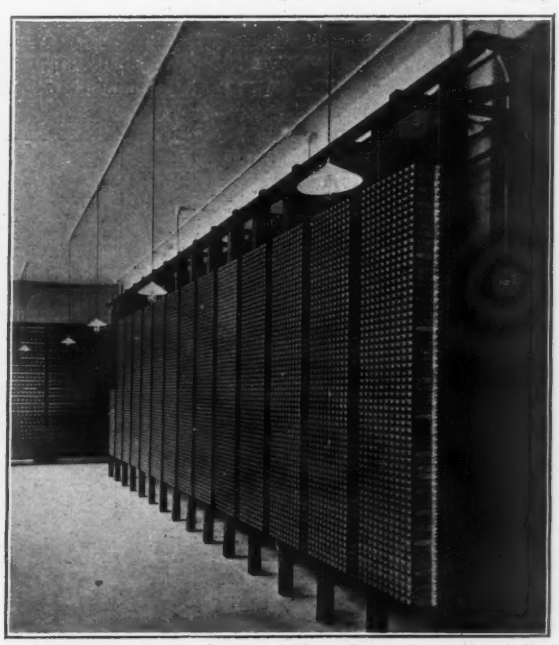


FIG. 3.—SUBSCRIBERS' METER RACK.

THE NEW "AVENUE" TELEPHONE EXCHANGE (page 102).

The complete equipment of the sub-station, including motor-generator-booster set, battery and switchgear, was designed and carried out by the Tudor Accumulator Co., Ltd.

It is often maintained that storage batteries are unsuited for the rough conditions of colliery work. It may, therefore,

be of interest to mention, in conclusion, that the battery at Hucknall has now been in use for three years without giving any trouble; there has been no difficulty in keeping it in good order with the ordinary attendance available at the colliery, and at the present time it is in excellent condition.

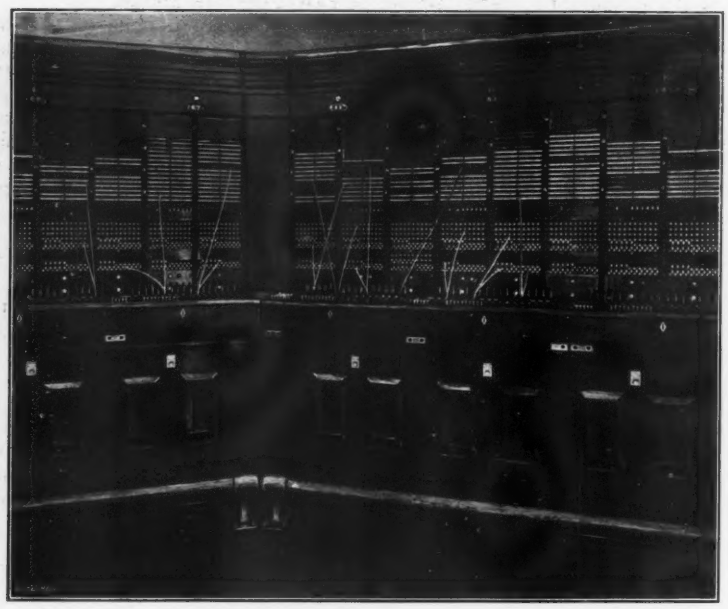


Fig. 4.—Subscribers' Switchboard; Section showing Ancillaries.

The author wishes to express his thanks to Mr. W. Maurice and to the Tudor Accumulator Co., Ltd., for permission to use the information given in this article.

THE NEW "AVENUE" EXCHANGE.

The new central-battery telephone exchange in Creechurch Lane, E.C., which has been equipped for the Post Office by the Peel-Conner Telephone Works, Ltd., is now ready for use. The switchboard, like that installed by the same company at Glasgow, is of their 40-volt type, and accommodates 9,000 subscribers; it also embodies some features of interest which are new to this country, and make it one of the most up-to-date equipments in Europe. The exchange is housed in a new building purchased by the Post Office, which, though not erected for the purpose, has proved to be readily adaptable to the needs of the case.

The main cable rack and battery room are in the basement; the test room is on the ground floor, and contains the main and intermediate distribution frames, relay racks, subscribers' meter racks, power plant, and test desks. The first floor is devoted entirely to the operating staff, being divided into kitchen, dining room and rest room, and the second and third floors respectively are the junction and subscribers' switch-rooms.

The street cables enter the basement from a manhole in the street, which receives 30 conduits from the north and 30 from the south; they are carried on a convenient type of cable rack and jointed to indoor 200-pair silk and cotton core lead-sheathed cables, which are led through cast-iron pipes to the main frame immediately above. Provision is made for forcing dry air through the street cables by means of nozzles and flexible tubes connected to the main air supply. The number of wires in a street cable, which was at most 434 eight years ago, has now been increased to no fewer than 1,600, thus greatly augmenting the carrying capacity of the conduits; nine of these large cables at present enter the cable chamber, as well as nine of 1,200 wires each, and four of 500 wires each.

A general view of the test room is given in one of the accompanying illustrations (p. 101). The main distribution frame is 11 ft. high and 41 ft. long; on the line side it carries 760 glass tube fuse mountings each fitted for 40 fuses, and on the vertical side each strip is fitted with arrester bars, with heat coils and lightning arresters for 200 circuits, the total capacity being 9,000 subscribers' lines, and 4,400 junctions and miscellaneous circuits.

The intermediate distribution frame, of the standard P.O. pattern, runs parallel with the main frame, the connecting cables being carried on wrought-iron runs; the relay rack comes next, fitted for 9,000 exchange lines and 1,200 miscellaneous relays and resistance spools, and lastly, the meter rack, which we illustrate, is designed for the ultimate equipment of 9,000 meters—one for each subscriber, suggesting, no doubt, that the ultimate intention is to make the measured rate universal.

At one end of the test room is the junction repeating coil and condenser rack with a capacity of 1,728 coils and 3,456 condensers; repeating coils are not required for subscribers' connecting cord circuits on the Peel-Conner system. The fuse cabinet, fitted with alarm and indicating fuses, the fault and test clerks' desks, and the power plant are also on this floor. We give below a view of the machines, which are of an improved type; hitherto the Post Office exchanges have been equipped with one storage battery and one or two motor-generators, which were used to charge the battery and supply the exchange in parallel with it, the voltage on the exchange therefore being subject to considerable variation. The motor-generators installed in the new exchange are provided with boosters, so that the battery can be charged while the generator continues to supply the exchange at constant voltage. Improved provision has also been made for recording the energy supplied from the street mains and that consumed by the telephone apparatus, as well as the current going to the latter and to or from the battery.

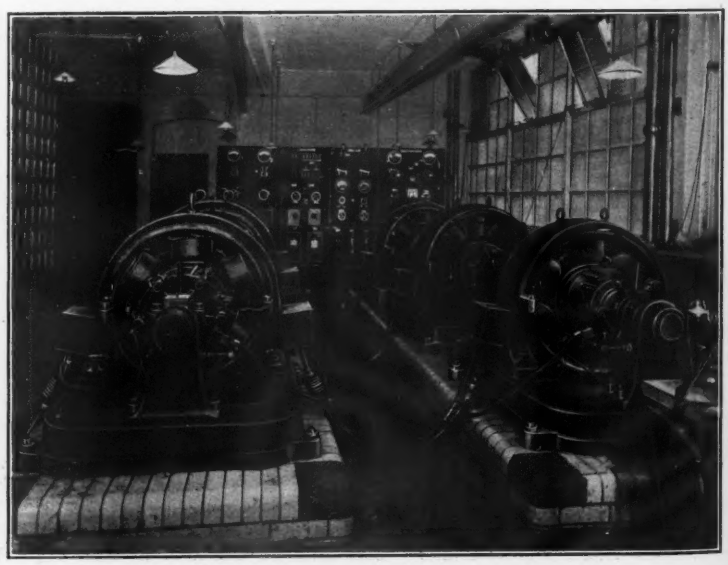
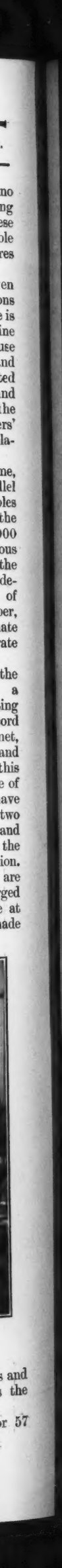


Fig. 5.—Charging Machines.

The junction switchboard is at present equipped for 57



positions; of these three are wired for trunk purposes, one for electrophone distribution, two for testing and plugging up faulty lines, eight for local transfer working, and the remainder for incoming calls from other London exchanges. With the exception of the trunks and a few ringing junctions, the whole of the circuits are arranged for keyless ringing. The present equipment per position is 30 circuits, with an ultimate capacity of 36 circuits. A 12-position information desk is provided, taking the place of the inquiry desks formerly used, and fulfilling other purposes also. The apparatus connected with the junction positions is conveniently arranged on vertical racks behind and at right

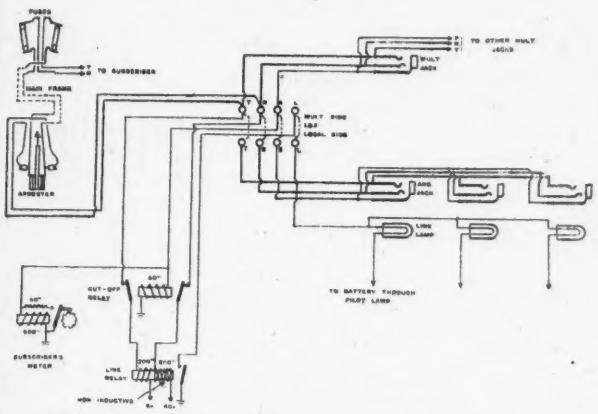


FIG. 6.—SUBSCRIBER'S LINE CIRCUIT WITH ANCILLARY JACKS.

angles to the switchboard, where the relays, &c., are readily accessible. Fig. 2, p. 101, shows the end section of the board.

On the top floor are switchboards equipped for 123 subscribers' answering positions, dealing with all calls originating with subscribers connected to the exchange. There is no subscribers' multiple on this board, as most of the calls are for subscribers connected with other exchanges; the junction sections, however, are fitted with a full multiple of subscribers' lines every nine panels, and local calls are completed at the junction switchboard by means of keyless transfer circuits. These transfer circuits are multipled on the answering positions on outgoing junction jacks, and are plug-ended at the transfer position at the junction switchboard; the answering positions may be considered as made up of three groups of 41 positions per group, each subscriber having a lamp and jack in each of the three groups.

The primary answering jacks are arranged on the switchboard at the bottom of the various panels, in the space usually occupied by answering jacks, the auxiliary answering jacks being immediately above them. The circuits with primary answering jacks in the first group of positions have ancillary answering jacks in the second and third groups. Similarly those with primary jacks in the second group have ancillary jacks in the third and first groups; and those with primary jacks in the third group have ancillaries in the first and second groups.

The above arrangement has been adopted for the following reasons, amongst others:—

1. The subscribers' calls are answered more promptly, as the signal appears in more than one position, and the calls are taken up more quickly.

2. The distribution of the traffic is rendered more even, and the work of each operator is made more uniform.

3. The method is useful for purposes of concentration at night and during periods of light load, as all the subscribers have answering jacks and lamps on one-third of the total answering positions, and it is only necessary for operators to be at these positions.

A subscribers' line circuit wired on this system is clearly shown in fig. 6, the three answering jacks and lamps being connected in parallel. The circuit is equipped with the usual line and cut-off relays, and it will be noted that the insertion of the answering plug in any one of the three jacks extinguishes all three lamps.

As in other London exchanges, the calls between subscribers in different exchanges constitute the major portion of the traffic, and the rapid and accurate working of junction lines becomes a most important factor. A considerable saving in the time of operating the junction circuits is effected by the use of keyless-ringing circuits. Each junction or "B" position has provision for 36 keyless incoming junctions and a present equipment of 30 junctions. It is estimated that this method of working junction circuits admits of 25 per cent. more junctions being worked from one position than is possible on existing switchboards without keyless circuits.

The circuits of a keyless junction will be clearly seen from fig. 7, and the operation of the circuit very briefly is as follows:—

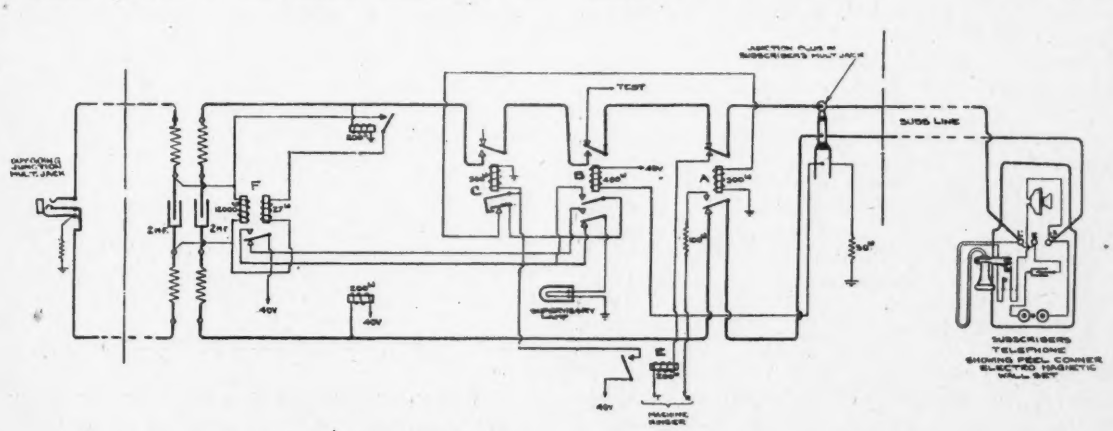


FIG. 7.—INCOMING C.B. JUNCTION FROM C.B. EXCHANGE; KEYLESS RINGING.

signalling is automatic, and complete supervision is given at each position.

The special feature of the subscribers' calling circuits is the use of the "ancillary jack" system.

Each subscriber's circuit is equipped with three answering jacks and lamps, situated at different points on the switchboard. One of the three jacks may be described as the primary answering jack and the others as auxiliary answering jacks, the circumstance differentiating the one class from the other being that a disengaged operator, in front of whom two lamps (one a primary and the other an auxiliary) light up simultaneously, will answer the call of the primary lamp in preference to the other. The total of 123 subscribers'

The request from a distant exchange for a connection is given over an order wire. The "B" operator at Avenue Exchange allots a disengaged junction circuit, and the distant operator inserts the calling plug of the pair in use into the corresponding junction jack of the same circuit. The "Avenue" operator at the same time inserts the incoming junction plug into the multiple jack of the required subscriber's line if it is disengaged. Through the insertion of the two plugs, relays "B" and "F" are operated, which close the circuit through the winding of relay "A," and so allow ringing current to pass out to the subscriber's line.

It will be noted that the ringing control relay "A" cannot operate until relay "F" is actuated. This is arranged

to prevent false calls, should the distant operator take up a wrong junction.

Upon the subscriber removing his receiver from the hook the 1,000 ω bell and condenser in his instrument are shunted by the talking circuit, which allows battery current to flow through the relay "E," which now pulls up and in its turn operates relay "C," which locks up until either plug is removed. The actuating of this relay opens the circuit through the relay "A" and the ringing current is removed from the subscriber's line.

The supervision of the conversation is maintained from the originating end, and should it be necessary to ring the called subscriber again owing to his having left his telephone (with receiver restored), the distant operator has only to remove the plug from the jack and re-insert it, when the ringing will be recommenced. The clearing signal to the "Avenue" operator is given by the taking down of the connection by the operator at the outgoing junction end.

The circuit described and shown in the diagram, fig. 7, is arranged for order-wire working from a C.B. Exchange, and illustrates a typical junction. The same principle of keyless working is applied to junctions from magneto and C.B.S. Exchanges, whether arranged for order-wire working or for calling direct on the junction line, in which cases, of course, the circuits are equipped to suit their own particular requirements.

The quantity of apparatus used in the construction of the exchange includes 250,000 jacks, 30,000 lamps, 35,000 relays, 6,000 miles of wire, and 3,000,000 soldered connections.

The installation has been completed well within the contract time of six months, in spite of the delays due to the recent strikes in Manchester, which practically stopped the work for several weeks, owing to the impossibility of getting any material on to the site. This time, it is claimed, constitutes a record for an installation of this magnitude. The whole of the apparatus is of British manufacture, and was installed by British labour with British capital.

REVIEWS.

Steam Turbine Design, with special reference to the reaction type, including chapters on condensers and propeller design. By John Morrow, M.Sc. London: Edward Arnold. Price 16s. net.

We have had a perfect plethora of books about the steam turbine during the last four or five years. There are the well-known treatises of Stodola, Jude, Hobart and Stevens, Richardson (on the Parsons turbine) and others. Therefore, our first question on looking at a new volume on this subject must inevitably be—"In what way does it differ from those which have already appeared?" Anyone who knows a little thermodynamics can write a book about steam turbines; it requires a man with some considerable ability to write one such that the details of design can be readily understood by the reader. In this respect (we are glad to be able to say) the author of the new treatise justifies its publication. We are not at all sure that the publishers will justify the somewhat exorbitant price. It is, we suppose, quite true that the man who has to design steam turbines can as easily afford to pay 16s. as 6s., and if the book had been written entirely for the drawing offices of the firms manufacturing steam turbines we should have had nothing to say. But the matter is not quite so simple, for the author says most distinctly that it is written "for designers, draughtsmen and students." The latter class are certainly more moneyed nowadays than they were in the days when the reviewer was at college, if they can afford to pay that amount for a book on one section (steam turbine design) of one subject (heat engines) of a curriculum which usually includes, in addition to the subject mentioned, structures, machines, electrical technology, surveying, hydraulics, &c. —all of which have to be learnt (more or less) in some three years.

While there is a good deal which merits praise in other parts of the book, we quite easily give the author fullest credit for the chapters on thermodynamics. That on heat diagrams is excellent. We are rather at a loss to explain why the author thought fit to use up two pages of his preface in dealing with the matter of irreversible operations. A short chapter on thermodynamics might have been considered necessary, but it was apparently the author's intention to omit any such work at first; more or less as an afterthought he included it in the preface. However, we can readily forgive him that, for he does give a very useful chapter on heat diagrams. Not the least interesting fact about the steam turbine is the extraordinary manner in which it illustrates how valuable was the work done in the 'eighties by those who wrestled with entropy and the only heat diagram then known.

Since that day we have had Moliere's diagram, and others (not quite so useful) have been suggested. Now, we have Morrow's diagram, the only objection to which is the use of a logarithmic scale. However, the diagram itself is quite good. Volumes and heat contents are measured along rectangular co-ordinates; and as these quantities are those mostly used in steam turbine design, the diagram should be most useful. The steam tables of Marks and Davis have been used, and although these are probably the best published at this present time, yet, of course, the most consistent tables are those based upon the work of Callendar, and used by Moliere in the compilation of his tables. (We understand that Prof. C. A. M. Smith and Mr. Warren are about to publish steam tables in British units based on Callendar's work.) The use of heat diagrams certainly provides the engineer with a new tool.

We notice that the Fahrenheit scale of temperature is used, despite the efforts of Ewing, Perry, and others, who are trying to introduce the Centigrade system of temperature, and retain the foot-pound. Of course, there is nothing to justify the Fahrenheit scale, but we think it will be some time before it is abandoned by British engineers. On page 36 we come across the term "rank of energy," and on going further we find it is used by the author in a way slightly different to, but resembling, "availability of heat energy," as other writers put it. The author means almost its temperature height. We think the word "rank" is most unfortunate, when we remember Perry's strenuous efforts to get it accepted as a unit of entropy—in compliment to Rankine. We are sorry to say that fig. 20 (page 55) is somewhat misleading. Long before the water curve gets down near the part shown on the diagram it disappears, and the *ice* (change of state) appears on the diagram.

The book is extremely good when the design of turbines is discussed, and we must assume that the author had some privileged method of obtaining many points culled from practice. The chapter on condensers is good, although the marine type only is dealt with (indeed, the book smacks of marine practice rather than central station work, throughout). The illustrations might have been a good deal worse, and could possibly have been a little better. The impression that one obtains is that the author has not kept quite rigidly enough to his subject, as stated in the title of the book. But we are quite confident in stating that any man who wishes to design steam turbines must have this volume by him. It is a valuable addition to the rapidly-growing literature on steam turbines.

A French Aluminium Process.—L'Aluminium Française, of Paris, is the title of a new undertaking which has been formed with the participation of important French aluminium manufacturing companies, for the purpose of producing nitrogen products for the manufacture of aluminium according to the process of the Société Générale des Nitrures. The new company has secured the exclusive right to use the process, and will also deal in aluminium and work it into manufactures. The share capital has been provisionally fixed at £200,000, and it can be increased to £600,000, apart from a gradual issue of bonds of from £600,000 to £800,000. It is proposed to erect branch works in the United States.

Russia.—A fact of interest to exporters of electrical goods to Russia is that the Government have now decided to give the haven of Libau the equipment needed for the import trade. Libau is the only Russian port which is ice-free throughout the winter, but its arrangements for dealing with cargo have hitherto prevented its use by all but the smallest ships. Large works are now to be undertaken, which will place the port on a level with the most up-to-date.—*Elektrotechnische Nachrichten.*

CONTRACTS OPEN.

(*Continued from page* 98.)

Hopfgarten (Tyrol).—February 13th. Construction of a generating station. Particulars from the Marktgemeindevorstehung, Hopfgarten.

Hornsey.—January 25th. Extension of Temperley transporter, for the T.C. See "Official Notices" January 12th.

February 7th.—Electricity meters, cables and cable stores, for the T.C. See "Official Notices" to-day.

Italy.—Tenders will be received, within 60 days from December 20th, at the office of the "Presidente del Consiglio Generale dell' Ente Autonomo Volturno, Piazza Municipio 37," Naples, for the supply and erection of machinery and apparatus, as well as hydraulic, electric and general accessories, required in connection with the central electric generating station in Naples. For further particulars see this column last week.

Leeds.—February 14th and 21st. (*a*) 1,000 A.C. meters and (*b*) 40,000 tons of steam coal and stores for a year, for the City Electric Lighting Department. See "Official Notices" to-day.

London.—L.C.C.—January 23rd. 3,500 tons of steel girder tramway track rails and fastenings, and 1,500 tons of slot rails and conductor tees. Specifications, forms of tender, and drawings, £2 (returnable), from the Chief Engineer's Department, County Hall, London, S.W.

January 30th.—Electrical installation at the School of Photo-Engraving and Lithography. See "Official Notices" to-day.

STEPNEY.—January 29th. The B.C. is inviting tenders for one E.H.T. converting plant, suitable for 6,000-volt three-phase A.C. to L.T. D.C., together with E.H.T. and L.T. switchgear, &c., for the Limehouse and Whitechapel stations. See "Official Notices" January 12th.

Morocco.—February 5th. The Moroccan Adjudications Commission intends to make a contract, by private arrangement after competition, for the supply and delivery of machinery and tools, and the supply and installation of two steam engines and of electric lighting plant, for an engineering workshop to be established at Tangier for the repair of lighters, &c. Applications from firms desirous of tendering to "M. le Président de la Commission Générale des Adjudications et des Marchés, Dar En Niaba," Tangier. The general regulations (in French) may be seen at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.—*Board of Trade Journal.*

Nuneaton.—January 24th. One 500-KW. mixed-pressure turbo-generator, with condensing plant, pipework, &c., for the Corporation. See "Official Notices" January 5th.

Plymouth.—January 20th. Stores for a year, for the Corporation Electricity and Street Lighting Departments. See "Official Notices" January 5th.

Portugal.—March 2nd. The "Conselho de Administração do Porto de Lisboa," Lisbon, invites tenders for the supply of 10 electric cranes, in accordance with the specifications which may be seen at the offices. Deposit 1,500 milreis (about £300) required to qualify any tender, which amount must be increased by the successful tenderer to 7 per cent. of the accepted price. Each of the 10 cranes must have a lifting capacity of 1,500 kg., but four of them must also be capable of lifting material up to 3,000 kg. in weight.—*Board of Trade Journal.*

Prague.—January 31st. Supply of two turbo-generators, of a normal capacity of 3,600 KW., with accessories. Particulars, plans, &c., from Städtischen Kanzlei der Elektricitätscentrale, Prague VII, and tenders to Haupteinreichungsprotokolle der Electrischen Unternehmungen, Altstädter Markthalle, Prague, Austria.

Rhyl.—January 31st. 1,700 yards of ·1 overhead feeder cable, for the U.D.C. See "Official Notices" to-day.

Siam.—BANGKOK. March 15th. Tenders are invited for the supply and erection of an electric power station with a capacity of 3,000 KW. Tenders, on the prescribed forms, to the Ministry of Local Government, Bangkok. For further particulars see this column for November 24th.

Spain.—The municipal authorities of Dolores (province of Alicante) have just invited tenders for the concession for the electric lighting of the town during a period of 10 years.

Tunbridge Wells.—February 10th. High and low-tension switchgear, for the Corporation. See "Official Notices" January 12th.

Turkey.—February 20th. Tenders will be received at the "Ministère des Travaux Publics," Constantinople, for a concession for the supply of electric light and power to the town of Adalia, which has a population of some 30,000. For particulars see this column December 22nd.

York.—Electric shunting locomotive for the Corporation. See "Official Notices" January 12th.

CLOSED.

Australia.—SYDNEY.—According to the *Australian Mining Standard*, the City Council has approved of the acceptance of the following tenders for sundry services:—

Conduits at generating station, construction of additional.—J. Stewart and Co., £9,845.
House transformers.—Australian General Electric Co., £508.
Flame arc lamps.—Union Electric Co., £1,873.

It was agreed to purchase 50,000 yards of fibre conduit, required for high-tension cable extensions in various municipalities, from Messrs. Haes & Eggers, representing the Key Manufacturing Co., Manchester, England, at an estimated cost of £4,690.

Approval was given for the payment to Messrs. Dick, Kerr & Co. of £1,500 for extras on contract for two 4,000-KW. turbo-generators, in addition to the sum of £575 authorised by the Council on August 1st, 1911.

Our contemporary also records the following tenders accepted for the Postmaster-General's Department, Victoria:—

Repeating coils, test-jacks, common-battery switchboards, &c.—J. Bartram and Son Pty., Ltd., Melbourne, £2,676.
Cords, gravity-restoring bull's-eye indicators, jacks.—British Insulated and Helsby Cables, Ltd., £442.
12 sections of a common-battery switchboard, at the Post Office, Ballarat.—Western Electric Co. (Australia), £4,265.
Jacks, electrical registers, line and cut-off relays, switchboard cable.—Western Electric Co. (Australia), Ltd., £519.
5 miles of telephone cable, at £185 per mile; 10 miles ditto, at £120 per mile; 10 miles ditto, at £72 per mile; total £2,845.—Western Electric Co. (Australia), Ltd.

Bradford.—Mr. H. Moss, of Bradford, has secured an order for the supply and erection of a 49-KW. generator, switchboard, cables, &c., for the Beacon Dyeing Co., Ltd. He is also supplying motors to Messrs. Hirst & Sons, which will be worked from the above plant.

Chesterfield.—The T.C. has accepted the tender of Messrs. Belliss & Morcom, Ltd., for a 750-KW. triple-expansion three-crank engine at 300 R.P.M., including steam separator and trap, at £2,250.

London.—The Metropolitan Asylums Board has accepted the tenders of Messrs. W. J. Fryer & Co. and Rhodes Motors, Ltd., at £36 for extensions to the electric lighting at Queen Mary's Hospital, and at £28 for the installation of larger motors to drive the mechanical stokers at Queen Mary's Hospital, respectively.

MARYLEBONE.—The B.C. has accepted the tender of Messrs. Babcock & Wilcox, at £480, for two internal superheaters for boilers at the electricity station.

SOUTHWARK.—The B.C. has provisionally accepted the following tenders:—

British Insulated and Helsby Cables, Ltd.—50 yards of 1·0 cable, £62.
Western Electric Co., Ltd.—220 yards of ·023 cable, £16; 440 yards of ·05 cable, £66.

Lowestoft.—The T.C. has accepted the following tenders for supplies to the Electricity Department:—

Motors.—British Thomson-Houston Co.
Meters.—Siemens, Ltd.
Carbon lamps.—Edison & Swan Co.
Metallic-filament lamps.—Electrical Co.

Newport (Mon.).—The B. of G. on Saturday accepted the tender of the Neville Engineering Co., Ltd., of Worcester, for an automatic push-button electric lift for the Workhouse Infirmary at £230.

Norwich.—The T.C. has accepted the tender of Messrs. Babcock & Wilcox, Ltd., for overhead coal-bunkers, conveyor, induced-draught fan, crane, grab, and provision for dampers and sundries, for the electricity works, at £3,495; and for two boilers, with superheaters and mechanical stokers, at £3,450.

Wednesbury.—The T.C. has accepted the tender of the Tudor Accumulator Co., Ltd., for the maintenance of the battery for a period of 10 years.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

Commanding Officer—LIEUT.-COL. H. M. LEAF.

The following orders are issued:—

Monday, January 22nd.—"A" Company. Technical work and musketry instruction (standard tests), 7 to 10 p.m.
Tuesday, January 23rd.—"B" Company. Technical work and musketry instruction (standard tests), 7 to 10 p.m.
Thursday, January 25th.—"C" Company. Technical work and musketry instruction (standard tests), 7 to 10 p.m.
Friday, January 26th.—"D" Company. Technical work and musketry instruction (standard tests), 7 to 10 p.m.
Saturday, January 27th.—Headquarters will be opened for regimental business from 10 a.m. to 12 noon.

(Signed) P. R. S. CAMPBELL, Capt. R.E. and Adjt.,
For Officer commanding L.E.E.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, January 19th. At 8 p.m. Paper on "The Evolution and Present Development of the Turbine Pump," by Messrs. E. Hopkinson and A. E. L. Chorlton.

Institution of Civil Engineers.—Friday, January 19th. At 8 p.m. Students' meeting. Paper on "The Turbo-Blower and Turbo-Compressor," by Mr. G. Ingram.

Tuesday, January 23rd.—At 8 p.m. Paper on "The Central Heating and Power Plant of the McGill University, Montreal," by Mr. R. J. Durley (time permitting).

Faraday House Old Students' Association.—Friday, January 19th. At 8.30 p.m. At the Holborn Restaurant. Annual smoking concert.

Royal Institution.—Friday, January 19th. At 9 p.m. Discourse on "Heat Problems," by Prof. Sir J. Dewar.

Friday, January 26th.—At 9 p.m. Discourse on "The Pressure of a Blow," by Prof. B. Hopkinson.

Junior Institution of Engineers.—Saturday, January 20th. At 9.30 a.m. Visit to the works of the Western Electric Co., Ltd., Woolwich.

Association of Engineers-in-Charge.—Saturday, January 20th. At 7.20 p.m. At St. Bride's Institute, E.C. Discussion on "The Various Systems of Warming Buildings."

Institution of Electrical Engineers (London).—Thursday, January 25th. At 8 p.m. Paper on "The Heat Paths in Electrical Machinery," by Messrs. M. Walker and H. D. Symons.

Physical Society.—Friday, January 26th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Exhibition of a Direct-Reading Instrument for Submarine Cable and other Calculations, by Mr. R. Appleyard; paper on "The Vibration Galvanometer and its Application to Inductance Bridges," by Mr. S. Butterworth; and "Note on a Negative Result connected with Radio-Activity," by Messrs. J. H. Vincent, M.A., and A. Bursill.

Institution of Electrical Engineers (Newcastle Local Section).—Saturday, January 27th. Smoking concert.

Institution of Electrical Engineers (Manchester Local Section).—Saturday, January 27th. At 7.30 p.m. At the University, Manchester. Meeting of the Manchester Association of Engineers. Paper on "Electrical Furnaces," by Mr. C. Myers.

NOTES.

Old Students' Dinner to Prof. Unwin.—Prof. Unwin being one of the very few teachers who have been honoured by being made President of the Institution of Civil Engineers, the Old Students' Association of the Central Technical College is organising a dinner to celebrate the occasion. The dinner is intended to be a gathering of all the old students of the Central Technical College and all Prof. Unwin's students at Cooper's Hill. It bids fair to be a very representative gathering of those who have had the advantage of Prof. Unwin's kindly teaching and advice. The Old Students' Association has asked us to draw attention to the dinner, as many of our readers have probably been students under Prof. Unwin and will wish to be present on the occasion. The dinner will be held at the Criterion Restaurant, Piccadilly, on Saturday, February 10th, at 7 for 7.30 p.m. The chair will be taken by the President of the "Central" Old Students' Association, Mr. W. Duddell, F.R.S. Those who wish to take part in the dinner should communicate with the Dinner Secretary, Mr. G. W. Tripp, 4, Fairfield Road, Charlton, Kent. The price of the tickets is 7s. 6d.

B.E. & A.M.A.—The annual general meeting of this Association will be held on Thursday, February 1st, at 2.30 p.m., at the offices, 36, Kingsway, London, W.C. The business to be transacted will include the presentation of the annual report and balance-sheet, and the election of a new Council. The following firms have recently been elected members of the Association, and we are asked to say that any member, unaware of the fact, who desires to nominate them for the new Council, will be economising time at the annual meeting by advising the secretary in advance of his intention:—W. H. Allen, Son & Co., Ltd.; Belliss & Morcom, Ltd.; Electric Construction Co., Ltd.; the Morgan Crucible Co., Ltd.; Siemens Bros. Dynamo Works, Ltd.; Switchgear and Cowans (1911), Ltd.; Willans & Robinson, Ltd.

Mining Exhibitions.—We are informed that the quarterly meeting of the Sub-Committee of the Northern Mining Industries Exhibitors' Committee was held at the Midland Hotel, Manchester, on January 9th, Mr. A. E. L. Chorlton (Messrs. Mather and Platt, Ltd.) in the chair. Amongst those present were Messrs. A. E. Mathewson (Tilghman Sand Blast Co., Ltd.), Walter Yates (Messrs. Matthews & Yates, Ltd.), J. Butterworth (Lancaster and Tonge, Ltd.). The Committee discussed a letter which the chairman had received from the secretary of the Colliery Exhibitors' Association, in which it was suggested that the two bodies should co-operate in connection with exhibitions. The secretary was instructed to write and express the desire of the Committee to co-operate in any way possible, while pointing out that the main object of the Northern Mining Industries Exhibitors' Committee was to promote exhibitions in the North of England, at such times as suited the trade, and that it had been decided to recommend the trade to hold one in Manchester in May or June, 1914.

Electricity in Agriculture.—Particulars were recently published in the *Standard* of an experimental application of electrical treatment to potato crops in Scotland, by Miss Dudgeon, of Lincluden, near Dumfries. The Lodge high-tension system was used on a plot of 8 acres, and the discharge was applied daily over a period of four months for 418 hours in all. A similar plot of land adjoining was untreated. The result was that the electrified area produced over 6 tons more than the control area. The trials will be continued this year.

Legal.—ALLEGED NUISANCE BY ELECTRIC MOTOR.—Mr. Justice Neville, in the Chancery Division, on Wednesday, concluded the hearing of the action of Jenkins and Others *v.* The Empire, Aberdare, Ltd., by which the plaintiffs, as trustees of a chapel, schools, and other buildings at Aberdare, sought to restrain an alleged nuisance arising from the electric lighting arrangements of the Aberdare Empire.

Evidence was given by experts for the defence to the effect that neither the noise nor vibration apparent in the defendants' buildings was sufficient to cause appreciable inconvenience. Mr. Peterson K.C., submitted that from the plaintiffs' own evidence it was clear that whatever might have been the result of working the old gas engine, since the installation of the dynamo there had been no appreciable vibration.

His Lordship said he need not trouble him as to the vibration.

Mr. Peterson said, with regard to noise, he contended that the plaintiffs had failed to prove that such noise could penetrate their buildings so as to amount to a legal nuisance, and his Lordship had had the evidence of the defendants' manager that no expense had been, or would be, spared in preventing any nuisance.

His Lordship, in giving judgment, said that, in his opinion, there was not sufficient evidence to support the claim as to vibration. He came to the conclusion, however, that there was sufficient noise from the electric motor to penetrate to the lecture hall and the minister's room, and to cause a legal nuisance. He must, therefore, grant an injunction to restrain the defendants permitting a nuisance to the plaintiffs' premises, but inasmuch as he thought that such nuisance as there was could be remedied and the plaintiffs had shown no alacrity in bringing their action, he would suspend the operation of the injunction for three months.

Inventors' Institute.—A meeting was held at the Inns of Court Hotel on Monday, Major W. A. Denny presiding, at which a large number of inventors, patent agents, and manufacturers' representatives attended to consider the founding of an Inventors' Institute. According to a daily paper the objects of the Institute are as follows:—

1. The protection of the rights and liberties of inventors and patentees.
2. The furtherance of their interests by procuring the passing of suitable Acts of Parliament removing existing hardships and anomalies.
3. The provision of lectures and discussions on matters or controversies of interest.
4. The assistance of members who are in difficulties.
5. The provision of funds for prosecuting or defending actions by or against members.
6. The granting of legal aid or advice and such other objects as shall benefit the work of its members.

Lord Minto is to be the first president.

Walking Club.—Arising out of the successful Electrical Trades London to Brighton Walking Race which was held last year, and in which H. E. Purnell, of the General Electric Co., won the Osram Cup, it has now been decided to form two walking clubs, one in the North of London (Hackney Walking Club) and the other in the South of London (Clapham Walking Club), and all particulars of same can be obtained from the respective secretaries, viz., Mr. S. C. Haynes, 20, Penda Road, Clapton Park, London, and Mr. A. R. Edwards, 47, Courtenay Road, Merton, London. Training quarters are being arranged for in both districts, and a programme of suitable strolls and races will be fixed up shortly.

Socials.—The Annual Fancy Dress Ball of the Robertson and Osram Social and Athletic Club was held on Saturday evening last at the Brook Green Works, Hammersmith. There were 320 present, including Mr. and Mrs. C. Wilson, Mr. and Mrs. E. G. Sheppard, and Mr. J. Brandon, L.C.C. Messrs. F. Pluck and J. Minson officiated as M.C.'s, and Messrs. G. H. Freeman and B. Philpot as honorary secretaries. The prizes presented to the successful employés and visitors were as under:—

Ladies: Employés.—1st prize, Miss M. Panymore (Sea Queen); 2nd prize, Miss M. Freeman (Japanese Girl); 3rd prize, Mrs. Bennett (Picture Palace); 4th prize, Miss E. Pearce (Folly); 5th prize, Miss H. Clarke (Road to Ruin).

Ladies: Visitors.—1st prize, Miss R. Vaux (Indian Girl); 2nd prize, Miss M. Loraine (Ice Queen).

Gentlemen: Employé.—1st prize, F. Snewin (Clown).

Gentlemen: Visitors.—1st prize, E. Alty (Red Indian); 2nd prize, G. E. Truss (Black Cat).

A gathering of the staff of the National Telephone Company in the Northampton centre was held at the Divan Café, Northampton, on 6th inst., to commemorate the transfer to the Post Office. About 40 were present, under the chairmanship of Mr. C. B. Robinson (chief inspector). The chairman presented the local manager, Mr. W. Dickinson, with a smoking cabinet, as a token of esteem, on the occasion of the transfer to the Post Office, by the members of the staff of the Northampton centre.

St. James' Electric Athletic Club.—The eleventh annual smoking concert of this club is to be held to-morrow (Saturday), January 20th, at 7.30 o'clock p.m., at the Pillar Hall, Victoria Station (S.E. & C.R.). The following artistes are announced to appear:—Miss Elsie Steadman, Messrs. Philip Ritte, Harrison Latimer, A. L. Taylor, Walter Churcher, Walter Montagu, Frank Powell, Will Edwards, Herbert J. Collings, Jock McPherson, and Geo. Swaine (accompanist).

Decision Under the Workmen's Compensation Act.—According to a report in the *Times* of January 11th, an interesting case under the Workmen's Compensation Act was brought forward at the Woolwich County Court, when his Honour Judge Granger announced his decision. The applicant was the widow of Richard George Schwartz, and the respondents were the India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd. The applicant's husband, acting on the instructions of the respondents, his employers, embarked in December, 1910, in the ss. *Axim* to proceed to Teneriffe, where he was to carry out some work for the company. About December 14th the *Axim* foundered with all hands in the Bay of Biscay. For the applicant it was argued that the case came within the Act, because the *Axim* was a British ship, and because the accident arose out of, and in the course of, the man's employment. The respondents denied that these circumstances entailed liability within the Act.

"His Honour now gave judgment for the respondents, expressing the opinion that although the accident arose out of, and in the course of, the man's employment, it was taken out of the Act because it could not be held that it occurred within the territorial limits of the United Kingdom. The section of the Act which included seamen, did not apply in this case, as the man was merely a passenger. Stay of execution was granted pending an appeal."

Electrical Banks in Germany.—A period of slightly over three years has elapsed since the formation of the Elektro Treuhand Gesellschaft as the financial organisation of the A.E.G. and the Siemens-Schuckert Works, for the purpose of financing large transactions and facilitating the establishment of supply works and tramways. The beginning of activity was, however, postponed to a later period, partly because the time was not favourable for large operations and partly because the founders themselves had ample funds at their own disposal. The share capital of the bank was to be £1,500,000, and bonds of three times this amount were also to be issued. It is now announced that the first transaction to be proceeded with will be in connection with the Hamburg Elevated Railway. It is understood that the bank will take over shares of £750,000 in the railway, and issue bonds of its own of a similar amount, the bonds having an additional guarantee based upon the working lease to be taken over by the manufacturing companies. Shortly after the constitution of this particular bank the Felten & Guilleaume Co. followed the example by forming a similar organisation. The latter, however, has not hitherto done any business, and the slight distribution of profits so far made has been derived from interest receipts. On the other hand, the financing company of the Bergmann Electricity Works—the Bergmann Electricity Enterprises Co.—was brought into existence at a later date, and has recently issued its first annual report. This shows a loss of £15,000 for 1910-11 on a paid up capital of £150,000 out of nominal capital of £600,000. It will, however, be necessary to call up further capital this year in connection with the construction of authorised electric railways in Upper Bavaria.

Electrical Copper Extraction Works.—The Electro-Chemical Co. is contemplating building an extraction works for copper in the south of Norway to utilise the method of Engineer Hybinette. The residue from pyrites works will be used as raw material, and apart from the chief product, copper, there will be produced purple ore, which represents an excellent raw material for the production of iron and steel.

Aluminium.—The world's production of aluminium in 1910 was, according to *Glückauf*, 34,000 tons, of which the United States and Canada produced 11,000 tons; Germany, Austria and Switzerland, 7,000 tons; France, 9,500 tons; England, 5,000; and Italy and Norway, 1,500 tons. The price fluctuated between 1·8 and 1·9 krone, which was higher than in 1909.

Fatality.—An inquiry was held at Crook (Co. Durham), on the 10th inst., into the circumstances of the death of John Brett, a wireman, living at Pease's West Colliery. The evidence showed that the deceased had been employed as a wireman at Bowden Close Colliery, owned by Messrs. Pease & Partners, for the past seven weeks, and had served previously under the same firm at Thorne, near Doncaster. On the 8th inst. he was engaged at Bowden Close fixing a temporary hand lamp. While doing so he ought to have switched off the current, but according to the evidence he had been making the connections while the wires were alive. He took hold of one of the wires, then cried out, and collapsed. He would receive a shock at 250 volts.—John Farrar said he heard Brett call out, and went to his assistance, and snatched the wires out of Brett's hands. The switch was then on, and the wires were alive.—The medical evidence was to the effect that death was due to shock due to contact with a live wire.—The Coroner said he thought it was a case of forgetfulness.—A verdict was returned to the effect that the deceased died from an electric shock, accidentally received.

Tramcar Accident Claim.—In the High Courts on Tuesday, January 16th, Mr. Justice Lush and a common jury awarded Annie Childs, a certificated nurse, £73 damages for injuries sustained whilst alighting from one of the London United Tramways Co.'s cars in the London Road, Twickenham, on August 13th last. The defendant company denied the negligence.

Midlands Electrical Engineers' Ball.—The first Midlands Electrical Engineers' Ball was held in the Grand Hotel, Birmingham, on Friday, 12th inst., when about 200 guests were present. The suite of rooms set apart for the hosts and their guests had been charmingly decorated, the entrance hall being quite transformed in appearance by an arrangement of bay trees, palms, and white and pink chrysanthemums, with a miniature fountain cunningly devised out of a block of natural ice, in the base of which gold fish were disporting themselves. Trailed with smilax, with carnations interspersed, and illuminated with electric lamps, the creation called forth many admiring comments. In the Grosvenor Room, where the dancing took place, the electroliers were entwined with smilax and Britannia carnations. Dancing commenced at 8.45, and continued until 2 o'clock, interrupted only by supper, at which the healths of Mr. R. A. Chattock, the City Electrical Engineer and Chairman of the Executive Committee of the ball, and Mrs. Chattock, were drunk with enthusiasm. We are informed that the extraordinary success of this, the first Midlands Electrical Engineers' Ball, will encourage the Executive Committee to make it an annual affair.

Finsbury Technical College O.S.A.—The fifth annual dance of this Association will be held at the Caxton Hall, Westminster, on Saturday, February 3rd, at 6.30 p.m. Pritchard's Band has been engaged. The price of tickets, including light refreshments, is 5s. Application should be made to Mr. John F. Shipley, Hon. Sec. for dance, 63, Shorrolds Road, Walham Green, S.W., as soon as possible.

Inquiries.—A correspondent who has been experimenting with tantalum wire finds that the smallest die he can get is $\frac{1}{1100}$, which leaves the wire far too thick for metal-filament lamps. He asks whether some reader will tell him how other firms are able to draw this kind of wire. If we are not mistaken, no one but Messrs. Siemens & Halske has been able to accomplish this feat.

A contracting firm which has had unsatisfactory experience with electric flashers wants a reliable one which will work for six months without attention. Information from readers who have had experience with mercury flashers is invited.

A correspondent who is troubled by the large starting currents of single-phase induction motors supplied from a 100-H.P. water turbine, asks what is the smallest starting current required by such motors of sizes up to 10 H.P., at 100 volts, 100 cycles.

Institution and Lecture Notes.—TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION.—The *Journal* for January contains the annual list of members. The annual dinner and smoking concert of the Association will be held on Friday, March 1st.

INSTITUTE OF METALS.—Prof. W. Gowland, the new President, on Tuesday was to have delivered his inaugural address on the subject of the early history of copper and its alloys. In his absence through illness, the paper was read by the Secretary.

Appointments Vacant.—Mains superintendent, for the Stoke-on-Trent Electrical Engineer's Department (£130); sub-station shift engineer, for the Bristol Electricity Department (30s.); assistant telegraph engineer for the Posts and Telegraphs Department of the Federated Malay States (£300); engineer for combined refuse destructor and electric light station for the Elland D.C. (£150); assistant engineer for the Tramways Department, Birmingham (£175); shift engineer for the Neath Electricity Works (25s.). See our advertisement pages in this issue.

For Sale.—The Eccles Corporation has for disposal one 120-KW. Browett, Lindley-Johnson & Phillips single-phase A.C. generating set, and one 25-KW. J. & P. motor-alternator set. See our advertisement pages in this issue.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—MR. W. J. GOURLAY, shift engineer, has been presented with a travelling clock by the staff of the Stuart Street station, Manchester Corporation, on his leaving to take up the appointment of station superintendent at Madras.

The Dundee Corporation Electricity Committee on Monday night unanimously recommended that the salary of MR. HARRY RICHARDSON, the engineer, be increased by £100, making it £700 per annum. Mr. Richardson was appointed in 1903 at a salary of £400 per annum, and has had much to do with recent important developments of the enterprise. In connection with the last big extension of the department, it was stated by the convener, Mr. Richardson saved to the Corporation about £4,000 in fees.

The Annual Ball of the Kilmarnock Tramways Department took place on January 15th in the Art Galleries. After supper the presentation of a Kodak was made to the engineer and manager, MR. A. H. BURBIDGE (who has been appointed tramways manager in Mandalay), by Mr. W. C. Bexon on behalf of the staff, and Councillor T. McKerrell also presented Mr. Burbidge with a chronometer on behalf of the Council. The remainder of a very enjoyable evening was taken up by singing and dancing.

On Saturday last MR. EGERTON SAYER was entertained at a farewell dinner given by his late assistants and employés at Hampstead, when he was presented with a handsome silver watch and a parchment signed by those who had subscribed to the present. A silver rose bowl was at the same time handed to him for Mrs. Sayer. The

dinner was followed by an excellent concert arranged by Mr. Harry Widden, a late assistant of Mr. Sayer, and a very successful evening resulted, marred only by the thought that it would be in all probability the last one in company with the guest, a man who has ever been popular. The evening closed with the singing of Auld Lang Syne and vigorous handshakes with Mr. Sayer.

General.—The Wirral Joint Hospital Board has appointed MR. A. P. PORTWAY, of Hoylake, as electrician at the hospital.

MR. NORMAN MITCHELL has resigned his position with the Kensington and Knightsbridge Electric Lighting Co., Ltd., in order to take up a position with Messrs. Duncan Watson and Co., as manager of a new branch opened by them in the South of England.

The Stretford U.D.C. has decided to reappoint MR. T. L. MILLER consulting engineer for one year at a fee of 25 guineas, to cover the following services :—(1) Conference as may be necessary from time to time with the Electricity Committee, or its chairman, or its engineer ; (2) quarterly preparation and submission of reports on the working of the station and condition of the plant.

The Committee of the City and Guilds Technical College, Finsbury, have appointed MR. J. K. CATTERSON-SMITH to be chief assistant to the Professor of Electrical Engineering.

MESSRS. HOOGHWINKEL & THURSFIELD, consulting engineers, of Leeds and London, are dissolving their partnership. After February 1st all communications should be addressed to Mr. Hooghwinkel, at his London office, 24, Martin's Lane, Cannon Street, E.C.

MR. F. DOUGLAS WATSON, late provincial superintendent for the National Telephone Co. in Scotland, who has been appointed general manager and secretary of the Société Anonyme Ottomane des Téléphones de Constantinople (Constantinople Telephone Co.), left Paris by Oriental Express on Saturday, the 13th inst., to take up his duties in Constantinople.

Obituary.—The death is reported from Darlington as having occurred on the 15th inst., of Mr. C. J. O'DOWD, traffic manager of the Corporation electric tramways. Years ago Mr. O'Dowd drove the first horse car in Dublin, and was also engaged on the Leicester tramways. He was for a number of years associated with the late Sir Clifton Robinson, and went from Stockton to Darlington when the Imperial Tramways Co. took over the old horse cars prior to installing the electric system, with a view to connecting Tees-side and Skerneside. When Darlington Corporation decided to construct and manage the new system, Mr. O'Dowd was appointed traffic manager.

The *Times* contains an announcement to the effect that the death occurred on January 11th at Hong Kong, of pneumonia, of MR. CHARLES THOMAS HOSE, of the Eastern Extension Telegraph Co., son of Bishop Hose, at the age of 31 years.

We regret to learn of the death, at the age of 80 years, of MR. S. W. JOHNSON, a past president of the Institution of Mechanical Engineers, who, in the course of his career, has been chief mechanical engineer of the Midland, North British, and Great Eastern Railways.

NEW COMPANIES REGISTERED.

Pintsch's Electric Manufacturing Co., Ltd. (119,600).—This company was registered on January 9th, with a capital of £30,000 in £5 shares, to acquire patents and rights relating to processes for lighting or heating railway carriages, tramcars and other vehicles, ships, boats, buildings or structures, and to adopt an agreement between Julius Pintsch Aktiengesellschaft of the first part, H. Grob of the second part, Pintsch's Patent Lighting Co. of the third part, and this company of the fourth part. The subscribers (with one share each) are :—C. P. Whitcombe, Durward House, Kensington Court, W., civil engineer; F. R. C. Worsley, Friars House, New Broad Street, E.C., company secretary. Private company. The number of directors is to be four ; the first are A. Pintsch and Dr. A. Golinelli (appointed by Julius Pintsch Aktiengesellschaft) and C. P. Whitcombe and F. R. C. Worsley appointed by Pintsch Patent Lighting Co., Ltd. Registered office, Friars House, Old Broad Street, E.C.

Barker Patents Syndicate, Ltd. (119,548).—This company was registered on January 6th, with a capital of £1,000 in £1 shares, to carry on the business of heating, electrical and general engineers, chemists, contractors, scientific instrument manufacturers, &c. The subscribers (with one share each) are :—A. H. Barker, 82, Bromley Road, Beckenham, consulting engineer; G. P. Stickney, 50, Elmwood Road, Chiswick, W., secretary. Private company. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first ; remuneration not more than 10 per cent. of the distributed profits. Registered office, 199, Strand, W.C.

Mirfield Garage and Electric Works, Ltd. (119,654).—This company was registered on January 12th, with a capital of £1,000 in £5 shares, to take over the business of an electrician, motor dealer and automobile and cycle engineer, carried on by Frances Alice Morton, at Nettleton Road, Mirfield, Yorks., as "A. Morton & Co." The subscribers (with one share each) are :—T. W. Sproulle, Easthorpe Grove, Mirfield, surgeon and physician; E. B. Wilson, Quarry Gap, Mirfield, solicitor. Private company. The numbers of directors is not to be less than three or more than five; the first are T. W. Sproulle, E. B. Wilson, E. W. Lee, T. Nevin and R. F. Walker; qualification, £25. Registered by Jordan & Sons, Ltd., 116-17, Chancery Lane, W.C.

Edwin Noel, Ltd. (119,614).—This company was registered on January 10th, with a capital of £5,000 in £1 shares, to acquire an invention in relation to wireless telegraphy and all the patents granted to R. C. Galletto, in respect thereof, and to carry on the business of electrical engineers, contractors for the supply of electricity, dealers in all kinds of electric, magnetic and galvanic appliances, instruments and apparatus, &c. The subscribers (with one share each) are :—A. W. Boon, 18, Fleet Street, E.C., secretary; H. J. Gulliver, 18, Fleet Street, E.C., clerk. Private company. The number of directors is not to be less than two or more than five ; the subscribers are to appoint the first; qualification, £50; remuneration as fixed by the company. Registered by Amery Parkes & Co., 18, Fleet Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Pacific and European Telegraph Co., Ltd. (36,683).—Capital £100,000 in £10 shares. Return dated November 29th (filed November 29th), 1911. All shares taken up. £4 per share called up. £40,000 paid. Mortgages and charges : £78,900.

Anglo-Norwegian Aluminium Co., Ltd. (92,830).—Mortgage on raw materials supplied to and remaining in possession of Nigelands Brug, whether in raw state or course of manufacture, and the aluminium or other products made thereon; and net proceeds of sale of all aluminium sold to date but unpaid for, and certain moneys owing to company, dated December 5th, and as further security for prior charge dated January 31st, 1911, securing £15,000. Holders: German Bank of London, Ltd., 31, Old Broad Street, E.C.

Electromobile Co., Ltd. (75,139).—Issue on December 14th, of £164 5s. debentures, part of a series of which particulars have already been filed.

English Electrical Co., Ltd. (112,639).—Issue on December 9th, 1911, of £1,000 debentures, part of a series of which particulars have already been filed.

General Electric Co., Ltd. ((67,307).—Mortgage dated December 21st, 1911, supplemental to trust deed dated November 30th, 1900, securing £200,000 first mortgage debenture stock, charged on land at Witton, near Birmingham. Trustees: F. B. Ross, Cromford Court, Manchester; and W. Warburton, 15, Norfolk Street, Manchester.

Sunbeam Lamp Co., Ltd. (25,498).—Issue on January 5th, 1912, of £5,000 debentures, part of a series of which particulars have already been filed.

Sheerness and District Electric Power and Traction Co., Ltd. (65,749c).—Issue on December 30th, 1911, of £600 debentures, part of a series of which particulars have already been filed.

"Electrical Engineer," Ltd. (104,347).—Mortgage debenture dated December 21st, 1911, to secure £2,336 2s. 5d., charged on copyright of the *Electrical Engineer*, and the company's undertaking and property, present and future, including uncalled capital. Holders: Smith's Printing Co. (London and St. Albans), Ltd., 28-32, Hutton Street, Whitefriars, E.C.

"Hart" Accumulator Co., Ltd. (60,059).—A memorandum of satisfaction in full on January 1st, 1912, of mortgage dated July 15th, 1909, securing £4,500, has been filed.

Musselburgh and District Electric Light and Traction Co., Ltd. (85,169).—A memorandum of satisfaction to the extent of £500 on January 2nd, 1912, of mortgages dated November 13th, 1905 and May 11th, 1909, securing £90,000, has been filed.

Max Follert & Co., Ltd.—Particulars of £600 debentures, created December 20th, 1911, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of present issue being £300. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Issue on December 20th, 1911, of £100 debentures, part of a series of which particulars have already been filed.

Yarmouth (I.W.) Electricity Supply Co., Ltd. (56,884).—Return dated November 8th, filed November 13th, 1911. Capital £5,000 in £5 shares. 347 shares taken up. £1,735 paid. Mortgages and charges : Nil.

National Conduit and Cable Co., Ltd. (59,251).—Return dated November 28th, filed December 8th, 1911. Capital £1,000 in £1 shares. All shares taken up. £7 paid. £993 considered as paid. Mortgages and charges : Nil.

Anchor Cable Co., Ltd. (69,073).—A memorandum of satisfaction on December 14th, 1911, of charge dated March 17th, 1904, securing unspecified amount (stamped to cover £10,000), has been filed.

Nairobi Electric Power and Lighting Co., Ltd. (87,728).—Issue on December 13th, 1911, of £200 debenture bonds, part of a series of which particulars have already been filed.

CITY NOTES.

Llandudno and Colwyn Bay Electric Railway, Ltd.

THE accounts for the year to November 30th, 1911, show a profit, after providing for operating and administrative expenses, interest on loan and debenture stock, amounting to £5,784. The amount brought forward from last account was £2,328, of which there has been expended in special track repair and renewal work, £1,413, leaving £915, making a total available balance of £6,699. There has been placed to depreciation reserve account (making a total to date of £3,000), £1,000, and to writing off balance of expenses of loans, per last account, £2,500, leaving £3,199. Out of this the directors recommend a dividend at the rate of 2½ per cent. per annum (payable, less income-tax, on January 31st, 1912), £2,485, leaving to be carried forward, £714. The traffic receipts show an increase of £634 over those of the previous year.

In accordance with the recommendation in the last report, a considerable portion of the track in Llandudno and Colwyn Bay has been overhauled, and special expenditure in this direction, amounting to £1,413, has been charged against the balance brought forward from last year's accounts. During the year the line between Rhôs-on-Sea and the top of Penrhyn Hill, a distance of about two miles, has been double-tracked, and in certain places improvements have been effected in the grades and curves. These alterations have proved of great advantage in handling heavy traffic during the summer season, and have contributed to the increase in takings. No settlement has yet been effected with regard to widenings in connection with the extension to Old Colwyn; but, if a reasonable arrangement can be made with the local authority, the work can be commenced next year.

The sixth ordinary general meeting was held on Friday at Basildon House, Moorgate Street, E.C., Mr. A. W. Tait presiding.

The CHAIRMAN, in moving the adoption of the report, said that the profit for the year had amounted to £5,784, as compared with £3,612 for the previous year, being an increase of £2,172. That increase might be regarded as fairly satisfactory, and was due to

an increase in the traffic and miscellaneous receipts, and to a reduction in expenses. The traffic receipts amounted to £15,359, as compared with £14,725, showing an increase of £634. That increase was encouraging, when it was remembered that the traffic during part of the year was somewhat interfered with by the construction of the double track on part of the road. The Coronation also kept away a number of visitors in the district during the early summer, and the takings in August were somewhat affected by the railway strike. It was only reasonable to expect that given fair weather during the coming summer they would be able to show a further increase during the current year. The miscellaneous receipts showed an increase of £325. The power expenses showed a decrease of £474, and it would interest them to know that they had used during the year 70,174 less units, although they had run 6,269 more car-miles. The traffic expenses showed an increase of £11, repairs and maintenance a decrease of £197, and the general expenses had decreased by £454, due to the absence of special expenditure and the reduction of directors' fees. Interest on loans showed a decrease of £132. During the year a considerable part of the track in Llandudno and Colwyn Bay had been overhauled, and special expenditure in this connection, amounting to £1,413, had been charged against the balance brought forward from last year's account. In the early part of the year they were able to make satisfactory arrangements with certain parties which enabled them to proceed with a doubling of a portion of the line. The double track had been completed for a distance of about two miles between Rhôs-on-Sea and the top of Penrhyn Hill, and in the process of construction they were enabled to effect improvements in the grades and curves at certain places. That had tended to a more efficient service, and they had been enabled to reduce the time of the through journey, which was of considerable importance in dealing with the "rush" traffic in the summer. The capital expenditure during the year had increased from £123,514 to £133,085. They had recently concluded arrangements for the acquisition of a quarry at Penrhyn Hill, whereby they would be able to effect a saving in the cost of material for road maintenance and other purposes. The directors were now in negotiation with a view of obtaining the right to double track a further portion of the line, as they thought it was of the greatest importance to have as much of the line as possible double tracked in order to cope with the summer traffic. No settlement had yet been arrived at with regard to widenings in connection with the extension to Old Colwyn. They had made an offer as to the amount which they considered the company should be called upon to contribute for road widenings, but so far they had been unable to arrive at a settlement. Whilst they believed that the construction of the extension would be a considerable public convenience, they could not advise the construction to be proceeded with unless the Colwyn Bay Council were reasonable in their demands. They had, however, intimated to them that immediately a settlement of the question could be effected they were prepared to proceed with the work. No further progress had been made with regard to obtaining the right to Sunday running, although he observed that recently there had been considerable expression of opinion by residents in the public Press as to the benefits which Sunday running would give to the public at large. It was unfortunate that North Wales should be behind the North of Scotland in recognising that Sunday running would not only be of benefit to the public at large, but would also be of considerable assistance to parties who wished to attend public worship. He felt sure the shareholders would appreciate the considerable improvement which had been made in the company's affairs during the year, not only by the further construction work which had been carried out, and which had enabled them to run the service more expeditiously, but also by the fact that they had consolidated their indebtedness by means of the issue of debenture stock. If reasonable arrangements could be made for the extension to Old Colwyn, their prospects for the current year ought to be further improved.

MR. GEORGE BALFOUR, in seconding the motion, said it was a source of great pleasure to the directors to know that they had been able to decrease the expenses and at the same time improve the service, because he was satisfied that the improvement was permanent so long as they had the traffic. He was pleased to say that even during the winter the improvement in the receipts had amounted to about 12 per cent., while their working expenses were lower. If they could do that in the winter they had every reason to believe that the company would be a highly successful undertaking, and that in future years they would be able to go on paying improved dividends regularly.

The CHAIRMAN, in reply to a shareholder, said that with regard to Sunday running, an arrangement was made some time ago by which they had the right to take a poll of the inhabitants once in three years. That poll was taken 1½ years ago, so that the right would not arise again for another 18 months. There was, however, no reason why the residents themselves should not ask the Council to approach the company in order that a Sunday service might be given. There was a growing tendency on the part of the public to show their dissatisfaction at the absence of Sunday running, and he need hardly say that if the residents decided that they wanted Sunday trams, the company would be only too willing to supply them. With regard to the expense ratio, that had been decreased during the year by 10 per cent.—last year it was 62 per cent., while this year it was 52 per cent.

The report was adopted.

Dublin United Tramways, Ltd.—The directors have announced a dividend of 6 per cent. per annum and a bonus of 1s. per share for the half-year, carrying forward £10,374.

The French Compagnie Générale d'Electricité.—The report for 1910-11 of the Compagnie Générale d'Electricité, of Paris, which has an ordinary share capital of £720,000, records profits of £320,000, of which £220,000 represents extraordinary profits derived from large transactions carried out during the year. Among these are mentioned the transfer of the company's station at Nantes to the Empain group and the sale of the Rouen station for £500,000 to the Centrale d'Energie Electrique, belonging to the Thomson-Houston group. The dividend amounts to 8 per cent., £205,000 has been placed to the reserve fund, and £53,900 has been carried forward. During the year the company participated in the formation of the Compagnie Générale Radiotélégraphique and in the new Compagnia Generale Italiana di Elettricita, of Milan, and a considerable portion of the capital in the Energia Elettrica de Catalana, of Barcelona, has also been acquired.

The Madrid Amalgamation.—The Union Electrica Madrilena is the title selected for the amalgamation of electric supply undertakings in Madrid, to which reference was made a week ago. It is composed of the General Madrid Electricity Co., whose bonds are largely in French ownership, the Sociedad de Gasificacion and the Bolarque Waterfall Co. (Salto de Bolarque), and it forms a syndicate with the Electricity Co. of Chamberé. The share capital amounts to 33,000,000 pesetas and the bond capital to 14,000,000 pesetas. The hope is expressed in Madrid that the constitution of the union represents the beginning of a general amalgamation of electricity producers in Madrid.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to :—

Marconi's Wireless Telegraph Co., Ltd.—Further issue of 250,000 ordinary shares of £1 each (issued at £1 premium), 10s. paid (of which 2s. 6d. is capital and 7s. 6d. premium) (Nos. 750,001 to 1,000,000).

Puebla Tramway, Light and Power Co.—Scrip, fully and partly paid, for $3,600,000 prior lien 5 per cent. 50-year gold bonds.

The Committee has ordered the undermentioned securities to be quoted in the Official List :—

Commercial Cable Co.—£35,101 additional sterling 500-year 4 per cent. debenture stock.

Montreal Water and Power Co.—Further issue of £20,000 4½ per cent. first mortgage prior lien gold bonds of £100 each, Nos. 8,498 to 8,697.

East London Railway Co.—In their report just issued the directors state that the question of electrification has advanced considerably since the last report, and the arrangement foreshadowed in the chairman's speech at the half-yearly meeting, under which the money for the electrification would be advanced by the Great Eastern Railway Co., had been embodied in the Bill which that company was promoting for the forthcoming Session of Parliament. The main provisions are as under :—The Great Eastern Railway Co. to provide the capital, and the lessee companies, including the Great Eastern, to guarantee interest of £4 per cent. in the proportion of the liability of each of them under the lease. The East London Railway Co. to apply any receipts exceeding the *minimum* of £30,000 per annum secured to them under the lease, to the payment of this interest. A survey has already been made by the engineers of the Metropolitan, Metropolitan District, and South Eastern Companies, and specifications and drawings have been completed for the sub-station machinery and equipment, electrical equipment of the track, and automatic signalling. It is proposed to obtain the supply of electrical energy from the Metropolitan District Railway Co.'s generating station at Lot's Road, and to feed it to the rails through their existing sub-station at Whitechapel, and through a new sub-station which it is proposed to build at Deptford. In connection with and as a part of the electrification a new passenger station will be provided between Surrey Docks (formerly Deptford Road) and New Cross Stations the plans for which are in hand.

Montreal Light, Heat and Power Co.—The directors announce a dividend of 2 per cent. on the paid-up capital stock (being at the rate of 8 per cent. per annum) for the quarter ending January 31st.

British Columbia Electric Railway Co.—The directors announce a dividend at the rate of 5 per cent. per annum on the 5 per cent. non-accumulative preferred ordinary stock for the half-year ended December 31st, 1911, together with an additional dividend at the rate of 1 per cent. per annum for the same period.

City and South London Railway Co.—The accounts for the half-year ended December 31st show a balance, after providing for debenture interest and preference dividends and the transfer of £1,500 to the renewal fund, sufficient to allow the payment of a dividend on the consolidated ordinary stock at the rate of 1¼ per cent. per annum, carrying forward £2,814. The dividend for the corresponding half-year was at the rate of 1¼ per cent. per annum.

Kaministiquia Water and Power Co.—The directors have declared a dividend of 1 per cent. for the quarter ending January 31st, being at the rate of 4 per cent. per annum, payable on February 15th.

British Electric Traction Co., Ltd.—It is announced that the directors have, after conference with representative shareholders, appointed Mr. G. T. Symons and Mr. C. G. Tegetmeier to fill the vacancies on the board until the next annual general meeting

MARKET QUOTATIONS.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and may vary according to quantities and other circumstances.

Wednesday, January 17th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a „ Nitric	„	22/-	..
a „ Oxalic	per lb.	2¾d.	..
a „ Sulphuric	per cwt.	5/6	..
a Ammoniac Sal	„	42/-	..
a Ammonia, Muriate (large crystal)	per ton	£29 10	..
a Bleaching powder	„	£5 10	..
a Bisulphide of Carbon	„	£18	..
a Borax	„	£16	..
a Ferro-Silicon (45 %)	„	£12 12 6	..
a Copper Sulphate	„	£23 10	£3 10 inc.
a Lead, Nitrate	„	£25 10	..
a „ White Sugar	„	£22 15	..
a „ Peroxide	„	£32	..
c Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	3¾d.	..
a Potash, Caustic (80/82 %)	per ton	£20 5	..
a „ Chlorate	per lb.	3½d.	..
a „ Perchlorate	„	4½d.	..
a Potassium, Cyanide (98/100 %)	„	7½d.	..
a Shellac	per cwt.	68/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	„	£6 10	..
a „ Recovered	„	£5 10	..
a „ Lump	„	£5 6	..
a Soda, Caustic (white 70/72 %)	„	£10 5	15/- dec.
a „ Chlorate	per lb.	3⅜d.	..
a „ Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
a „ Cyanide (basis 100 %)	„	7d.	..
d „ „ („ 128/130 %)	„	..	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£65	£2 inc.
b „ Wire, in ton lots	„	£102	..
b „ Sheet, in ton lots	„	£120	..
p Babbitt's metal ingots	„	£92 10 £145	..
c Brass (rolled metal 2" to 12" basis)	per lb.	8d.	..
c „ Tube (brazed)	„	10½d.	..
c „ „ (solid drawn)	„	8¾d.	..
c „ Wire, basis	„	7⅞d.	..
c Copper Tubes (brazed)	„	10⅝d.	..
c „ „ (solid drawn)	„	10d.	..
g „ Bars (best selected)	per ton	£80	£1 inc.
g „ Sheet	„	£80	£1 inc.
g „ Rod	„	£80	£1 inc.
d „ (Electrolytic) Bars	„	£96 10	10/- dec.
d „ „ Sheets	„	£83 10	10/- dec.
d „ „ Rods	„	£71 10	10/- dec.
d „ „ H.C. Wire	per lb.	8½d.	..
f Ebonite Rod	„	5/8	..
f „ Sheet	„	4/9	..
n German Silver Wire	„	1/11	..
h Gutta-percha, fine	„	5/- to 7/-	..
h India-rubber, Para fine	„	4/7	⅜d. inc.
l Iron Pig (Cleveland warrants)	per ton	49/10½	8d. dec.
l „ Wire, galv. No. 8, P.O. qual.		£14	..
g Lead, English Pig	„	£15 5 to £15 7 6	12/6 inc.
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£8	..
e Mica (in original cases) small	per lb.	6d. to 2s.	..
e „ „ „ medium	„	2/6 to 4/-	..
e „ „ large	„	4/6 to 8/6	..
p Phosphor Bronze, plain castings	„	11d.	..
p „ „ rolled bars & rods	„	1/0½	..
p „ „ rolled strip & sheet	„	1/1	..
o Platinum	per oz.	185/-	..
d Silicium Bronze Wire	per lb.	9½d.	¼d. dec.
r Steel Magnet, in bars	per ton	£55	..
g Tin, Block (English)	„	£193 to £195 nom.	£2 inc.
n „ Wire, Nos. 1 to 16	per lb.	2/4	..
p White Anti-friction Metals	per ton	£45 to £150	..
k Zinc, Sh't (Vieille Montagne bnd.)	„	£31 2 6	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

STOCKS AND SHARES.

Tuesday Evening.

THE Stock Exchange is, like the traditional curate's egg, good in parts. Some markets are but a sorry waste of desolate inactivity; in others there is the bustle of eager business, and amongst the latter the miniature boomlet in Rubber shares is an outstanding feature.

Home Railway stocks are moving in lively fashion, and, after being steeped in gloom, prices recovered upon the appearance of one or two rifts in the labour sky. Whether there be a coal strike or not, opinion is very general that the recent fall in quotations has largely discounted its earlier effects. Manifestly, too, a fair amount of bear selling has been in progress, and the partial closing of this position was of material aid to the rally.

Districts are still a wild market, and since we last wrote have been down 2½, to pick up the loss later on, so that on balance the change is only ¼ lower. Underground Electric Railway shares have hardened again after their substantial rise of last week. The Income Bonds, however, are unchanged. Metropolitan Consolidated retains its big improvement. Central London Ordinary, with City and South London, went back a little.

The only Underground shares which, so far as we are aware have not moved up during the revival created by the boom in London General Omnibus stock, are the £10 fully-paid Preferred issue of the Great Northern and City, the present price of which is 22s. 6d. middle.

With 'Bus stock still soaring, advantage was taken of the excitement to give London United Tramways Preference a hoist, and from 3⅞ the price jumped to 4 1/16 during the course of a few days. The pace was too hot to last, and, on the rise, shares came in which put the price back to 3¾, at which a gain of ⅛ remains on the week. Demand for the Debenture stock has also slackened, a point coming off the previous quotation. British Electric Traction First Debenture stock shows a rise of 1. Yorkshire 6 per cent. Preference shares are a little harder.

Changes in the Electricity Supply section are neither numerous nor important. Attention is being turned to Brompton Ordinary, on the good yield afforded by the shares, and the fact that they had not moved much of late. The price put on ¼, and Westminster Preference are 1/16 higher, although Westminster Ordinary are dull, yet the return on the last-named is more than 6 per cent. on the money, and the Company occupies a fine position. City "Lights" parted with ⅛ of their ⅜ advance. The various Debenture stocks are inclined to improve.

The feature in the Telegraph and Telephone section is violence of the fluctuations in Marconi shares. They touched 79s. 6d. slumped right away to 62s. 6d. within an hour, then climbed above to 70s., only to decline again. The Preference fell 5/16 in sympathy. As the immediate cause of the drop, the unwieldly nature of the bull position was the main factor. Dublin especially had been ardent in buying shares for which the purchasers could not pay, and when it was found that the shares could not all be carried over, the wild rush to sell forced the price down to 3⅛, at which support was again forthcoming. Quoted *ex* the dividend of 1s., the Ordinary at 3 5/16, are 9s. down on balance.

West India and Panama are to the fore again, after their little rest, and business has been done as high as 4 3/32. The rest of the telegraph market is somewhat supine. American Telephone and Telegraph capital stock rose 4, which is the more noticeable in view of the pronounced depression affecting American Railroad shares. Chili Telephones are about 1/16 higher, allowing for the dividend deducted, and United River Plates benefited to the extent of ¼. National Telephone Preference shares are lower, and speculation in the Deferred stock is dwindling. The price shows a shrinkage of another point, following upon the drop of 3½ last week. The proposal to take over the telegraph service in the United States by the American Government has occasioned considerable surprise.

Telegraph Constructions are 10s. better, and Babcock Ordinary have put on the half-crown which of recent weeks seem to have become a habit with them. Dick, Kerrs are a shade higher, and Crompton Debenture is 1 up. The Manufacturing division on the whole is very quiet.

Amongst Colonial and Foreign Electrical issues, Rangoon Preference stand out with a big rise of 7s. 6d., and the company's Debenture stock put on 2 points. Calcutta Trams also are harder at 5¾, and Calcutta Supply Ordinary have risen ⅛, so that it may be said that the fall consequent upon the change of capital in India has been recovered as regards the electric issues. Amongst the Latin-Canadians, Montreal Light, Heat and Power Common went back 4, which is not astonishing in view of the enormous rise that has lately taken place. Mexico Trams are a little easier, and so are Rios, but the general tendency of the group is steady. A few further *ex*-dividend markings have the effect of making prices look cheaper again. River Plate Ordinary strengthened to 255, showing a rise of 15 points, and the Preference continue to creep up. Canadian General Electric are also better as regards the Common shares, a rise of 2 taking the price to 114½. The steady investment buying of Anglo-Argentine Tramways Preference shares has further advanced the prices of those issues, the Seconds being ⅛ up. Some of the more recent buying has come from Ireland. Para Electric Ordinary put on ⅛, but the Preference declined to the same extent. Brisbanes are a little harder again, and in British Columbias there is very little doing.

The Siemens & Schuckert Companies.—It appears from the reports of recent annual meetings that as a consequence of the necessity for additional capital on the part of the Siemens-Schuckert Works, the two proprietary companies—the Siemens and Halske Co. and the Schuckert Electricity Co.—have decided to make a further non-terminable loan of £1,000,000 to the former, thus increasing this 6½ per cent. loan to £2,500,000. The half to be furnished by the Siemens & Halske Co. will apparently be provided out of current funds, whilst the Schuckert Co.'s half will be raised by the latter issuing new shares of £500,000. If still further money is needed it is stated that provision has been made for this purpose. The orders now on the books of the Siemens & Halske Co. and the Siemens-Schuckert Works show a large advance over the same period in 1911, and all the works are declared to be fully employed.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations Jan. 16th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bournemouth & Poole, Ord.	10	5½	5†	7⅞ — 8¼	..	6 5 9
Do. 4½ % Pref.	10	4½	4½	8¾ — 9¼	..	4 12 4
Do. Second 6 % Pref.	10	6	6	10½ — 11	..	5 9 1
Do. 4½ % Deb. Stock	Stock	4½	4½	100 —102	..	4 8 3
Brompton & Kensington, Ord.	5	10	9†	8 — 8½	+ ⅛	5 17 8
Do. 7 % Cum. Pref.	5	7	7	7½ — 8	..	4 7 6
Central Electric Supply, 4 % Guar. Deb.	100	4	4	98 —101	..	3 19 3
Charing Cross, West End & City	5	5	5†	3¾ — 4	..	6 5 0
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 4¾	..	4 14 9
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	3⅝ — 4¼	..	5 9 1
Do. Do. 4 % Deb.	100	4	4	93 — 96	..	4 3 4
Chelsea, Ord.	5	5	4†	4 — 4¼	..	5 11 1
Do. 4½ % Deb.	Stock	4½	4½	98 —101	+1	4 9 1
City of London, Ord.	10	7	6†	12⅞ — 13⅜	— ⅛	5 4 8
Do. 6 % Cum. Pref.	10	6	6	12 — 13	..	4 12 4
Do. 5 % Deb.	Stock	5	5	117 —121	..	4 2 8
Do. 4½ % Second Deb.	100	4½	4½	100 —103	..	4 7 5
County of Durham, 5 % First Mort. Deb.	Stock	5	5	87 — 89	..	5 12 4
County of London, Ord.	10	5	4†	9 — 9¼	..	5 5 3
Do. 6 % Pref.	10	6	6	11 — 11½	..	5 4 4
Do. 4½ % Deb.	Stock	4½	4½	103 —103	..	4 3 4
Do. 4½ % Second Deb.	Stock	4½	4½	100 —103	..	4 7 5
Edmundson's, Ord.	5	Nil	Nil	⅜ — ½	..	Nil
Do. 6 % Cum. Pref.	5	Nil	Nil	2 — 2¼	..	Nil
Do. 4½ % First Mort. Deb.	100	4½	4½	82 — 85 xd	..	5 5 11
Folkestone	5	6	6†	4¾ — 5	..	6 0 0
Do. 5 % Cum. Pref.	5	5	5	4¾ — 5⅛	..	4 17 7
Do. 4½ % First Deb.	100	4½	4½	95 — 98	..	4 11 10
Hove	5	9	8†	6½ — 7⅛	..	6 4 2
Kensington & Knightsbridge, Ord	5	9	8†	6⅞ — 7⅛	..	6 4 2
Do. 4 % Deb.	Stock	4	4	94 — 96	..	4 3 4
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	78 — 82 xd	..	5 9 9
London Electric, Ord.	3	2	..	1½ — 2	..	3 0 2
Do. 6 % Pref.	5	6	6	4¾ — 4¾	..	6 3 1
Do. 4 % First Mort. Deb.	Stock	4	4	88 — 91	..	4 8 0
Metropolitan	5	5	4†	3¾ — 4	..	6 5 0
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 4⅝	..	4 17 4
Do. 4½ % First Mort. Deb.	Stock	4½	4½	99 —104	..	4 6 7
Do. 3½ % Mort. Deb.	Stock	3½	3½	84 — 87	..	4 0 6
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	94½ — 96½	..	4 13 3
Newcastle-on-Tyne	5	4	4†	3¾ — 4	..	5 0 0
Do. 5 % Pref., Non-Cum.	5	5	5	4 — 4¼	..	5 11 1
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	99 —102	..	4 18 0
Notting Hill, 6 % Non-Cum. Pref.	10	..	..	9⅞ — 10⅜	..	..
Oxford	5	7½	6†	6½ — 6⅝	..	5 9 5
St. James' and Pall Mall, Ord.	5	10	10†	8 — 8½	..	5 17 8
Do. 7 % Pref.	5	7	7	6⅝ — 7⅛	..	4 19 1
Do. 3½ % Deb.	100	3½	3½	85 — 87	..	4 0 6
Smithfield Markets, Ord.	5	Nil	..	1⅛ — 1⅜	..	Nil
South London, Ord.	4	5	..	2¼ — 2½	..	6 3 1
Do. 5 % First Mort. Deb.	100	5	5	98 —101	..	4 19 0
South Metropolitan, 7 % Pref.	1	7	7	1 — ⅛	..	6 4 5
Do. 4½ % First Deb. Stock	100	4½	4½	96 — 99	+1	4 10 11
Urban, Ord.	5	5	..	⅛ — ⅜	..	..
Do. 5 % Cum. Pref.	5	5	..	2 — 2½	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	86 — 88	— ½	5 2 3
Westminster, Ord.	5	10	10†	7⅞ — 8¼	..	6 1 2
Do. 4½ % Cum. Pref.	5	4½	4½	4 13/16 — 5 1/16	+1/16	4 6 9

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5⅛ — 5⅜	..	5 4 4
Calcutta, Ord.	5	8½	7†	6⅛ — 6⅜	+ ⅛	6 6 0
Do. 5 % Pref.	5	5	5	5 — 5⅛	..	4 15 3
Calgary Power, 1st Mort. Bds.	100	5	5	93½ — 95½	— ½	5 4 9
Canadian Gen. El. Com.	$100	7	7†	112 —117	+2	5 19 8
Do. 7 % Pref.	$100	7	7	118 —122	..	5 14 9
Cordoba Lt., Power and T., Ord.	1	3	3†	¾ — 1	..	3 0 0
Do. 5 % Deb.	100	5	..	94 — 97	..	5 3 1
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	6	6	91 — 93	..	6 9 0
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	83 — 86	..	5 16 3
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	92 — 94	+ ½	5 6 5
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	3/16 — 3/8	+ 1/32	Nil
Do. 6 % Pref.	1	6	6	13/16 — 7/8	+ 3/32	7 7 8
Kaministiquia Power, 5 % G. Bs.	$500	5	5	102 —104	+ ½	4 16 2
Madras, Ord.	5	..	..	2⅜ — 3⅛	..	..
Melbourne, 6 % 1st Mort. Deb.	100	5	5	100 —102	+1⅛	4 18 0
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	87 — 89	+1	5 12 4
Mexican Lt. & Power, Common	$100	4	4†	86 — 88 xd	..	4 10 11
Do. 7 % Cum. Pref.	$100	7	7	107½ —109½	..	6 7 10
Do. 5 % 1st Mort. Gold Bds.	..	5	5	97½ — 99½	+1	5 0 6
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	89 — 91 xd	..	5 10 0
Montreal, Lt., H. and Power	$100	7	8	194 —198	—4	3 10 8
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	..	39 — 41	..	12 3 10
River Plate, Ord.	Stock	10	..	250 —260	+15	3 16 11
Do. 6 % Non-Cum. Pref.	Do.	6	6	107 —113	+1	5 7 2
Do. 5 % Deb. Stock	Do.	5	5	100½ —102½	+ ½	4 17 7
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	99 —101	..	4 9 1
Shawinigan Water, Capital	$100	4	5†	125 —127	— ¾	3 3 0
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	105 —107	..	4 13 6
Do. 4½ % Per. Deb.	Stock	4½	4½	102½ —104½	..	4 6 2
Toronto Power, 4½ % Deb.	Do.	4½	4½	99 —101	..	4 9 1
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	91— 93	..	5 7 6
Victoria Falls Power, Pref.	1	Nil	11¼d.	1/16 — 1/8	..	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	106½ —108½	..	5 10 7

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	Nil	4†	7 — 7⅛	..	..
Do. 5 % Deb. Red.	Stock	5	5	98 —100	..	5 0 0
American Telep. & Teleg., Cap.	$100	8	8†	144 —146	+4	5 9 7
Do. Collat. Trust	$1000	4	4	93 — 95	..	4 4 3
Anglo-American Telegraph	Stock	3⅜	3†	67 — 69	..	5 8 8
Do. 6 % Pref.	Do.	6	6	111 —112	..	5 7 2
Do. Def.	Do.	30/-	..	26½ — 27½	..	5 8 1
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	101 —103	..	4 17 1
Chili Telephone	5	7	..	7 1/16 — 7 5/16	+ 1/16	4 15 9
Commercial Cable, Stlg. 4 % Deb.	Stock	4	4	86 — 88	..	4 10 11
Cuba Telegraph	10	6	6†	10½ — 11	+ ½	5 9 1
Do. 10 % Pref.	10	10	10	17 — 18	..	5 11 1
Direct Spanish Telegraph, Ord.	5	4	4†	3½ — 3⅝	..	5 6 8
Do. 10 % Cum. Pref.	5	10	10	8½ — 8¾	..	5 14 3
Do. 4½ % Debs.	50	4½	4½	98½ —100½	..	4 9 7
Direct United States Cable	10	4½	..	7⅝ — 9⅜	+ ⅛	5 7 5
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	98½ —100½	..	4 9 7
Eastern Telegraph, Ord. Stock	Stock	7	5†	137 —140 xd	..	5 0 0
Do. 3½ % Pref. Stock	Do.	3½	3½	83 — 85 xd	..	4 2 4
Do. 4 % Mort. Deb.	Do.	4	4	101 —103	..	3 17 8
Eastern Extension	10	7	5†	13½ — 13⅝ xd	..	5 1 10
Do. 4 % Deb.	Stock	4	4	100½ —102½	..	3 18 1
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	99 —101	..	3 19 3
Globe Telegraph and Trust	10	5⅞	6†	10⅜ — 11½	..	5 6 8
Do. 6 % Pref.	10	6	6	12½ — 13½	..	4 10 9
Great Northern Telegraph	10	18	5†	3⅛ — 33	..	5 9 1
Indo-European Telegraph	25	13	5†	56½ — 58½	..	5 10 2
Mackay Companies Common	$100	5	5†	80 — 83	..	6 0 6
Do. 4 % Cum. Pref.	$100	4	4	69 — 72	..	5 11 1
Marconi's Wireless Telegraph	1	5	..	3⅛ — 3⅜	+9/16	..
Do. 7 % Cum. Partic. Pref.	1	16	..	2⅝ — 2⅞	— 1/16	..
Monte Video Telephone, Ord.	1	6	6	1⅜ — 1⅝	..	5 12 11
Do. 5 % Pref.	1	5	5	1⅛ — 1⅜	..	5 6 8
National Telephone, Pref.	Stock	6	6†	101½ —104½ xd	..	5 14 10
Do. Def.	Do.	6	6†	122½ —124½ xd	—1	4 16 5
Do. 6 % Cum. 1st Pref.	10	6	6	9¼ — 10 xd	— ¼	6 0 0
Do. 6 % Cum. 2nd Pref.	10	6	6	9¼ — 10 xd	— ¼	6 0 0
Do. 5 % Non-cum. 3rd Pref.	5	5	5	5 5/16 — 5 5/8	— 1/16	4 9 11
Do. 3½ % Deb.	Stock	3½	3½	98 —100	..	3 10 0
Do. 4 % Deb.	Do	4	4	98 —100	..	4 0 0
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	101⅜ —102⅜	+ ⅛	4 7 7
Oriental Telep. and Elec.	1	8	..	1⅛ — 1⅜	..	4 18 6
Do. 6 % Cum. Pref.	1	6	6	1 5/16 — 1 3/8	..	4 13 8
Do. 4 % Red. Deb.	Stock	4	4	87 — 89	..	4 9 11
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	98½ —100½	..	3 19 7
Reuter's	8	5	5†	8⅜ — 9½	..	4 6 6
Submarine Cables Trust	Cert.	6	6	130 —133	..	4 10 3
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	98 —100	..	4 10 0
United River Plate Telephone	5	8	8	7⅜ — 7⅝	+ ⅛	5 4 11
Do. 5 % Cum. Pref.	5	5	5	5⅛ — 5⅜	..	4 8 11
West Coast of America	2½	2½	2½	1 1/16 — 1 1/8	..	4 15 8
Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4	4	98½ —100½	..	3 19 7
West India and Panama Teleg.	10	1½	1½†	3⅛ — 4⅛	+ 1/16	2 19 8
Do. 6 % Cum. 1st Pref.	10	6	6	10⅜ — 10⅝	+ ⅛	5 10 4
Do. 6 % Cum. 2nd Pref.	10	6	6	9⅜ — 10⅛	..	5 17 1
Do. 5 % Debs.	100	5	5	102 —104	+1	4 16 2
Western Telegraph, Ltd.	10	7	6†	13½ — 14	..	5 0 0
Do. 4 % Deb.	Stock	4	4	99 —101	..	3 19 3
Western Union Tel., 4 % Bnds. A	$1000	4	4	106 —109	..	3 13 5
Do. 4½ % Fdg. Bonds	$1000	4½	4½	100 —103	..	4 7 5

*. Unless otherwise stated, all shares are fully paid. † Interim dividend.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations Jan. 16th.	Rise + or Fall —	Present Yield p.c.
	*					£ s. d.
Bath Trams, Pref. Ord.	1	Nil	Nil	⅛ — ⅝	..	Nil
Do. 5 % Pref.	1	5	5	⅝ — ¹¹⁄₁₆	..	7 5 6
Do. 4½ % Deb.	100	4½	4½	80 — 85	..	5 5 11
Brit. Elec. Trac., Ord.	10	Nil	Nil	..	..	..
Do. 6 % Pref.	10	1½	1½	..	..	..
Do. 5 % Deb.	100	5	5	94 — 97	+1	5 3 1
Do. 4½ % 2nd Deb.	100	4½	4½	79 — 83	..	5 8 5
Central London Railway, Ord.	100	3	3†	68 — 70	—1	4 5 9
Do. Pref.	100	4	4	84 — 86	—3	4 13 0
Do. Def.	100	2	..	56 — 58	—1	3 9 0
Do. 4 % Deb.	100	4	4	100 —102xd	..	3 18 5
City & South London, Ord.	100	1½	1½†	29 — 30	—1	5 0 0
Do. 5 % Pref., 1891	100	5	5	108 —110	..	4 11 0
Do. Do. 1896	100	5	5	104 —106	..	4 14 4
Do. Do. 1901	100	5	5	103 - 105	..	4 15 3
Do. Do. 1903	100	5	5	103 —105	..	4 15 3
Do. 4 % Deb.	100	4	4	101 —103	..	3 17 8
Dublin United Trams, 6 % Pref.	10	6	6	11 — 12	..	5 0 0
Great Northern & City, Pr'f. Ord	10	Nil	..	1 — 1½	..	Nil
Hastings Trams, 6 % Pref.	5	Nil	3†	⅛ — ¼	..	..
Do. 4½ % Deb.	100	4½	4½	73 — 78	..	5 14 8
Isle of Thanet Trams, 5 % Pref.	5	2½	2½	2⅜ — 2⅝	..	4 6 11
Do. 4 % Deb.	100	4	4	75 — 80	..	5 0 0
Lancashire United, 5 % Deb.	100	5	5	76½ — 79½	..	6 5 9
London Elec. Railw'ys, 4 % Deb.	100	4	4	97 — 99	..	4 0 10
London United Trams, 5 % Pref.	10	Nil	..	3½ — 4	+ ⅛	..
Do. 4 % Deb.	100	4	4	75 — 78	—1	5 2 7
Metropolitan Railway Consol.	100	1⅜	2†	46½ — 46⅝	..	2 18 10
Do. Surplus Lands	100	2⅜	3†	66 — 68	+ ⅜	4 0 11
Do. 3½ % Deb.	100	3½	3½	90 — 92 xd	..	3 16 1
Do. 3½ % Pref.	100	3½	3½	86 — 88	..	3 19 7
Do. 3½ % Con. Pref.	100	3½	3½	85 — 87	..	4 0 6
Metropolitan District Ord.	100	Nil	..	32⅜ — 33½	— ⅛	Nil
Do. 6 % Deb.	100	6	6	144 —146	..	4 2 2
Do. 4 % Deb.	100	4	4	95 — 97	..	4 2 6
Do. 4 % Prior Lien	100	4	4	100 —102	..	3 18 5
Do. 4½ % First Pref.	100	3½	4½†	91 — 93	..	3 10 0
Do. 3½ % Gtd.	100	3½	3½	76 — 78	..	4 9 9
Metropolitan Elec. Trams, Ord.	1	5½	5†	⅜ — 1 1/16	..	5 6 6
Do. Def.	1	Nil	..	1/32 — 1/16	..	Nil
Do. 5 % Pref.	1	5	5	1/32 — 3/32	..	5 3 1
Do. 4½ % Deb.	100	4½	4½	100 —102	..	4 8 3
Do. 5 % Deb.	100	5	5	101 —103	..	4 17 1
Potteries, Ord.	1	2	..	5/32 — 7/32	..	..
Do. 5 % Pref.	1	5	5	15/32 — 17/32	..	6 19 3
Do. 4½ % Deb.	100	4½	4½	90 — 93	— 1	4 16 9
South Metro. Trams, 6 % Pref.	1	6	..	⅜ — ½	..	6 17 2
Do. 4 % Deb.	100	4	4	70 — 75	..	5 6 8
Underground Elec. Railways	10	..	..	3 — 3⅛	+ ⅛	..
Do. 4½ % Bonds	100	4½	4½	99 —101	..	4 9 1
Do. 6 % Income	100	1	1½†	79 — 81	..	..
Do. Power House Debs.	100	4	4	100 —102	..	3 18 5
Yorkshire (West Riding), Ord.	5	Nil	..	¼ — ⅜	..	Nil
Do. 6 % Pref.	5	Nil	..	2⅜ — 3	+ ⅛	Nil
Do. 4½ % Deb.	100	4½	4½	80 — 85	..	5 6 0

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5	5½†	5 — 5⅛	+ 1/16	5 4 9
Do. 2nd Pref.	5	5	5½†	4⅛ — 5 1/16	+ ⅛	5 3 6
Do. 4 % Deb.	100	4	4	93½ — 95½	..	4 3 9
Do. 4½ % Deb.	100	4½	4½	100 —102	+1	4 8 3
Do. 5 % Deb.	100	5	5	101 —103	..	4 17 1
Auckland Trams, 5 % Deb.	100	5	5	102 —105	..	4 15 8
Bombay Elec. S. & Trams, Pref.	10	6	6	10⅞ — 11⅛	..	5 5 6
Do. 4½ % Deb.	100	4½	4½	96 — 98	..	4 11 10
Do. 5 % 2nd Deb.	100	5	5	96½ — 98½	..	5 1 6
Brisbane Trams Invt., Ord.	5	8	8†	8⅛ — 9⅛	+ ⅛	4 7 8
Do. 5 % Pref.	5	5	5	4⅞ — 5⅛	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	101 —104	..	4 1 7
B. Columbia Elec. Rly., Def.	100	8	8†	137 —142	..	5 12 8
Do. Pref. Ord.	100	6	6	120 —124	..	4 16 9
Do. 5 % Pref.	100	5	5	108½ —111½ xd	+2	4 9 8
Do. 4½ % 1st Mort. Deb.	40	4½	4½	100 —103	..	4 7 5
Do. 4½ % Vancouver Deb.	100	4½	4½	104 —106	..	4 4 11
Do. 4½ % Con. Deb.	100	4½	4½	102 —104	..	4 6 7
Calcutta Trams, Ord.	5	6	..	5½ — 6	+ ¼	5 0 0
Do. 5 % Pref.	5	5	5	4⅞ — 5⅛	..	4 17 7
Do. 4½ % Deb.	100	4½	4½	100 —103	..	4 7 5
Cape Electric Trams	1	Nil	2½†	⅞ — 1	..	4 0 0
City Buenos Aires Trams (1904)	5	5	5	5⅝ — 5⅞	..	4 5 1
Do. 4 % Deb.	100	5	5	95 — 98	..	5 2 0
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	93 — 98	..	5 2 0
Havana Elec. Rly., 5 % Bonds	$1000	5	5	100 —103 xd	..	4 17 1
Kalgoorlie Elec. Trams	1	Nil	..	1/32 — 3/32	..	Nil
Do. 5 % A Deb.	100	5	5	91 — 94	..	5 6 5
Do. 6 % B Deb.	100	5	6†	58 — 62	..	8 1 4
La Plata Elec. Trms, Prf.	1	6	6	33/32 — 1	..	6 0 0
Lisbon Elec. Trams, Ord.	1	5½	6†	1 — 1⅛	..	4 8 0
Do. 6 % Pref.	1	6	6	1 — 1⅛	..	4 16 0
Do. 5 % Deb.	100	5	5	93½ — 97½	..	5 2 7
Madras Elec. Tr. (1904), Deb.	100	5	5	93½ — 96½	..	5 3 8
Manaos Trams & Lt., 1st Deb.	100	5	5	90½ — 92½	..	5 8 1
Manila Elec. R. and Ltg., Bonds	$1000	5	5	100½ —102½	..	4 17 7
Mexico Trams Com.	$100	7	7†	123 —125 xd	+⅜	5 12 0
Do. Gen. Con. 5 % Bonds	..	5	5	99 —101	+ ½	4 19 0
Do. 6 % Bonds	100	6	6	101 —103	..	5 16 6
Para Elec. Rlys. & Lt., Ord.	5	10	10†	7 — 7⅜	+ ⅛	6 15 7
Do. 6 % Pref.	5	6	6	5½ — 5⅝	— ⅛	5 6 8
Do. 5 % 1st Deb.	100	5	5	97½ — 99½	..	5 0 6
Perth (W.A.) Elec. Tr., Ord.	1	2½	..	1⅜ — 1	..	2 10 0
Do. 5 % 1st. Deb.	100	5	5	99 —101	..	4 19 0
Rangoon El. Tr. & Sup., Pref.	5	6	6	5⅜ — 5⅞	+ ⅜	5 2 2
Do. 4½ % 1st Deb.	100	4½	4½	98 —101	+2	4 9 1
Rio de Janeiro Trams	$100	4½	5†	115 —116	—2	3 17 7
Do. 1st Mort. 5 % Bonds	..	5	5	101 —102	..	4 18 0
Do. 5 % Mort. Bonds	100	5	5	97 — 98	+ ⅛	5 2 0
Sao Paulo Tram, Lt. and P.	$100	10	10†	190 —194	—4	5 3 1
Do. 5 % 1st Deb.	$500	5	5	102 —104	+ ⅛	4 16 2
Singapore Trams, 5 % Deb.	100	5	5	81 — 84	..	5 19 1
Southern El. Tr. B.A., 5 % Deb.	100	5	5	95½ — 97½	..	5 2 7
Un. Elec. Trams Monte Video	5	6	7	5⅜ — 5⅝	..	5 2 2
Do. 6 % Pref.	5	6	6	5⅜ — 5⅝	..	5 10 4
Do. 5 % 1st Deb.	100	5	5	99⅜ —101⅛	..	4 18 6
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	104 —106	..	4 4 11

MANUFACTURING COMPANIES.

Aron, Ord.	1	Nil	6	⅜ — ⅝	..	..
Do. 6 % Pref.	1	9	6	29/32 — 31/32	..	7 2 2
Babcock & Wilcox	1	26	24†	6⅞ — 6⅞	+ ⅛	4 0 0
Do. Pref.	1	6	6	1⅜ — 1⅝	..	4 0 0
B.I. & Helsby Cables	5	10	8†	6⅝ — 7⅛	..	7 0 4
Do. Pref.	5	6	6	6⅛ — 6¼	..	4 16 0
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
British Thomson-Houston, Deb.	100	4½	4½	94 — 97	..	4 12 9
British Westinghouse, Pref.	3	Nil	..	1/32 — 3/32	..	Nil
Do. Deb.	100	4	4	54 — 57	..	7 0 4
Do. 6 % Prior Lien	100	6	6	100 —102	..	5 17 8
Browett, Lindley, Ord.	1	Nil	..	1/6 — 2/-	..	Nil
Do. Pref.	1	Nil	..	5/- — 6/-	..	Nil
Brush, Ord.	2	Nil	..	0 — 1/32	..	Nil
Do. 7 % Pref.	2	Nil	..	0 — 1/32	..	Nil
Do. 4½ % Deb.	100	4½	4½	56 — 61	..	7 7 7
Do. 4½ % Second Deb.	100	4½	4½	37 — 42	..	10 14 4
Callender's Cable	5	15	10†	9 — 9⅜	..	7 13 10
Do. Pref.	5	5	5	5 — 5⅛	..	4 15 3
Do. Deb.	100	4½	4½	99 —101	..	4 9 1
Castner-Kellner	1	17½	20	8⅜ — 8⅝	..	4 10 6
Do. Deb.	100	4½	4½	106 —110	+1	4 1 10
Crompton & Co.	3	Nil	Nil	⅛ — ⅜	..	Nil
Do. Deb.	100	5	5	58 — 68	..	7 7 1
Dick, Kerr	1	5	..	27/32 — 31/32	+ 3/32	5 3 1
Do. Pref.	1	6	6	1⅛ — 1 1/16	..	5 12 11
Do. Deb.	100	4½	4½	92½ — 95½	..	4 14 3
Edison & Swan, A, £3 paid	5	Nil	..	1/32 — 3/32	..	Nil
Do. fully paid	5	Nil	..	1/32 — 3/32	..	Nil
Do. 4 % Deb.	100	4	4	70 — 74	..	5 8 1
Do. 5 % Second Deb.	100	5	5	77 — 80	..	6 5 0
Electric Construction	2	Nil	2½†	3/32 — 5/32	..	..
Do. Pref.	2	7	7	1⅛ — 1⅜	..	7 9 4
Greenwood & Batley, Pref.	10	7	7	7¼ — 8¼	..	8 5 8
Do. Deb.	100	5	5	94 — 96	..	5 4 2
General Electric, Pref.	10	5	5	8¾ — 9⅛	..	5 8 1
Do. Deb.	100	4	4	85 — 90	..	4 8 11
Henley's, Ord.	5	15	10†	11⅞ — 12⅜	..	5 18 10
Do. Pref.	5	4½	4½	4 15/16 — 5 1/16	..	4 5 11
Do. Deb.	100	4½	4½	104 —105	..	4 4 11
India-Rubber, G. & T.	10	10	..	10 — 12	..	..
Do. Pref.	10	5	5	9⅛ — 10⅛	..	4 17 7
Telegraph Construction	12	20	10†	34½ — 36½	+ ½	6 17 0
Do. Deb.	100	4	4	99½ —101½	..	3 18 10
Willans & Robinson	1	Nil	..	1/32 — 3/32	..	Nil
Do. Pref.	5	Nil	..	⅛ — ⅜	..	Nil
Do. Deb.	100	4	4	58 — 63	..	7 2 10

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

The yields are calculated upon the dividends paid for 1910.

Bank rate of Discount 4 per cent., September 21st, 1911.

PROCEEDINGS OF INSTITUTIONS.

The Use of Electricity for the Control of Railways.

On Monday last week an interesting paper was read before the Derby Society of Engineers and Telegraph Superintendents of the Midland Railway, by Mr. J. Sayers, M.I.E.E., chairman of the society. The following is an abstract of the paper :—

The centre of gravity of the Midland system is at Derby, whence radiate the chief railway and telegraph lines, the latter including three lines worked quadruplex, two duplex, and two needle and bell circuits. The important circuits are kept out of signal boxes, where telephones are being largely substituted for telegraphs. All messages to stations not on the same circuit as the station of origin are sent to Skipton, whence they are forwarded to destination; the messages are prefixed by certain letters which indicate the comparative importance and urgency of each message, from D M, the danger signal, which demands instant attention, to D B, which stands next in urgency to a train letter. The average time occupied in the transmission of a telegram with the least important prefix ranges from 14 to 21 minutes; about 17 million telegrams are sent annually, averaging 19 words each, and the company has the right, in addition, to send 320,000 postal telegrams, aggregating 5,120,000 words, free of charge per annum.

The control of goods and mineral traffic on the sections of line roughly from Leeds to London, from Derby to Birmingham, and from Birmingham to Bristol, is carried out mainly by telephones. Three trunk telephone systems from the North, South, and West respectively centre at Derby, each having about six stations upon it, which stations are the main traffic centres; from these centres radiate other telephone circuits, some being extensions of the already existing telephone box circuits, and others telephone circuits superimposed upon an existing telegraph wire. By this combination the smallest local centre can communicate with, or be instructed by, either his immediate governing centre, or if necessary, by the head officers at Derby.

In the busiest sections of the line an accurate record is kept of the exact position of goods and mineral trains, by the control operator keeping continuously a day-book entry of all trains passing him; the state of his book is hourly sent telephonically to the local centre, and, this information being collated within a minute or two from all the stations in this neighbourhood, an accurate record is in front of the controller, showing him the exact positions of such trains at that particular moment.

This is transmitted instantly on one of five separate telegraph circuits to Derby, and the aggregation of the information from the five circuits enables the operator at Derby to move on a large scale model of the line (which includes all sidings and connections), and shows him at a glance how the trains are running. Their loading is also known, as well as the amount of traffic standing in sidings, and its nature and destination.

The net effect of this arrangement, which was designed by the general superintendent (Mr. C. W. Paget), has been to exercise such a control upon the loading, running, and speed of the goods and mineral trains on the chief lines of the Midland as to ensure that they are running at their maximum efficiency as regards weight behind the engine; at their maximum efficiency as regards the absence of unnecessary stopping and shunting, waiting at signals, &c., and with the maximum punctuality. I believe it is quite the usual thing for 90 per cent. of the controlled goods trains arriving at a place like Leeds to be punctual, fully loaded, and, in addition, very frequently to have run, say, from Masboro' to Hunslet, without a stop. This system of communication has been carried out with great economy, considering its size, largely on account of the invention of a telephone system for working on an existing telegraph wire without interfering with the telegraph service. At this moment the Midland employ 328 superimposed telephones, and they are rapidly increasing in number.

In the latest type of these telephones a high-class ordinary high-resistance receiver is used, and the telephonic currents are received from the line through what is called a phonoporic coil, which is really a transformer with discontinuous windings. There is, of course, some interference and noise from the telegraphic currents which traverse the transformer, chiefly owing to its electrostatic capacity, but an operator very soon gets used to this, and the speech is usually very good indeed.

As the operation of intermediate telegraph instruments would necessarily be continually breaking the line, and so cutting the conversation up, it is necessary to shunt each instrument with a two-microfarad condenser. The electrostatic capacity added to the line from this cause, and from the capacity of the telephones themselves, has no prejudicial effect upon ordinary telegraph circuits, and upon quadruplex circuits it is overcome by introducing balancing capacity in the usual manner.

The call on these circuits is given by an electrical vibrator, which operates an electric horn at each instrument, each station having, of course, its own code call. About eight superimposed telephones can be satisfactorily worked on one circuit.

Turning to the electrical control of running trains, personally, I think whether main-line trains are driven by steam or by electricity, they should be controlled as regards their movements by an actual man on the moving train, and his control should be regulated by communications from fixed visual signals, or, as may possibly be to some extent the case in the future, by electro-mechanical signals received by his train by contact, induction or radio-telegraphic means from the track.

The first is really the ideal arrangement, although the oldest and simplest, but for one thing—the obstruction due to fog or heavily falling snow. The ordinary method of replacing the proper sight of signals in fog is the use of men on the line at the distant signal, who, when the signal is "on," place a detonator on the line, and when the signal is "off" remove it. This system works remarkable well, although it appears to be crude, and its success is due to the use of distant signals.

It is extraordinary how many inventions have been taken out by people who probably do not understand what a distant signal is. Such inventions are always absolutely useless.

The difficulty with all these inventions is that they involve something moving at a speed varying from nothing to 90 miles per hour coming into mechanical contact with a stationary portion of the track, and it is extremely difficult to devise apparatus which shall make sufficient mechanical and electrical connection with the track when a train is stationary, and yet survive continuously the impact which the apparatus would sustain when moving at a high velocity.

So far as I know there is only one system of the kind which is reasonably successful at the present day, and that is "The Great Western system," which is in considerable use on certain lines of the Great Western railway, and which the Midland Co. have been trying for some years past on the Wirksworth branch with a very great measure of success.

The danger signal requires only the mechanical movement of the shoe on the engine due to its riding up and on the ramp, this movement opening a switch on the engine which, by the failure of the local current, operates a whistle that shows danger in the cab. If the signal is off, the ramp and rail have an E.M.F. of about 24 volts connected between them, and the breaking of the switch by the movement of the shoe mentioned above is counteracted on the engine by the received current from the ramp and rail, which cancels the danger signal on the whistle and substitutes a safety signal on a bell.

So far as I remember this system has never given a false signal to the driver in the direction of danger; what few failures there have been out of many thousands of indications, have been on the side of safety, indicating that the signal was "on" when it was really "off."

The difficulty of extending a system of this kind, apart from first cost (which becomes very great on an extensive line), is that engines from one centre run over very large portions of the line, especially if a period such as 12 months is considered, and it is therefore necessary, before converting even one section of the line, that the apparatus should be fixed on all engines which would possibly reach it. If the present method of fog-signalling were abolished, say between Leeds and Derby, it must be absolutely impossible for a single engine at any time to run over that section of the line unless it is fitted with the apparatus.

Apart from this difficulty, there is no doubt that this method of fog-signalling would be considerably dearer than the present, and the only advantage that really remains with it is due to the fact that it would always be ready for operation when a fog came on, whereas fog signalmen have to be called out, and there is a time at the beginning of a fog when the men are not at their posts. This has to be met at present by careful running, with the necessary delay.

After describing the lock and block system in use on the Midland railway, with safety checks to indicate whether signals have acted and whether lamps are burning, the author proceeds :—

The most important addition of recent years to the means for detecting the presence of trains on portions of the line which, for various reasons, are sections upon which a train should not be left or kept waiting without special attention, is that called the track circuit. The bonds used to make each line of rails metallically continuous consist of soft copper studs into which is brazed a No. 8 galvanised iron wire; the copper studs are driven into corresponding holes drilled into the web of the rail and are then compressed with a screw. This ensures an absolutely watertight and perfect contact with the rail, which is further secured by heavily coating it with red oxide paint.

A Midland insulated joint for insulating the section of track circuit from the continuing part of the line is made with vulcanised fibre sheets and tubes. The fibre for side plates is obtained in sheets ½ in. thick, which is cut into suitable sizes by a circular saw. Holes are then drilled to fit the bolts, after which the pieces are soaked in water until the fibre becomes sufficiently flexible to bend. They are then placed on a piece of 100-lb. rail with ordinary fish-plates on either side, bolted up and left on the rail and allowed to dry *slowly*—they must not be baked. They are then taken off and the holes enlarged to fit the ferrules, after which the edges are trimmed and the whole coated with red oxide paint. The end pieces are cut out of ¼-in. fibre sheet shaped to the section of the rail and painted. The ferrules are made from fibre tube so as to get the strength of the wrapping of the fibre. The tube is obtained as nearly as possible to the correct bore to fit the bolts, and the bolt holes in the rails are enlarged to driving fit.

The great advantage of this type of joint is that it gives the minimum amount of interference with the engineer's sections and the permanent way generally. After it is put in, the only precaution that the platelayer has to observe is that he must not slacken this joint at any time for variations of temperature. If it were allowed to become loose, the fish plate edges, rocking against the top and bottom of the rail, would very soon cut through the fibre.

At the entering end of the track circuit is connected a 9-ohm relay, and at the other end of the track circuit is connected a low-voltage large capacity battery (generally one lead accumulator) through a resistance which can be varied at will. On the contacts of the relay is connected a battery, working through a circuit to the signal box, which circuit usually traverses the coils of an electric lock, unlocking one or more signal levers, and also

traversing one or more indicators which show two indications—"Clear" and "Occupied."

A train entering from the entering end short circuits the rails, so reducing the potential on the relay coils to practically *nil*. The relay drops, and so breaks the contacts, maintaining the locking and indicating circuit. Immediately, therefore, the train touches the track, the lock drops into the signal protecting the train and prevents it being pulled off again, and the indicator shows "Line occupied."

If the train becomes at rest on the track circuit for any reason, proper or improper, it will hold the signal at danger behind it, and continue to show "Line occupied," so reminding the signalman of its presence.

On passing through, the train at last runs over a portion of the track where it short-circuits a resistance between the rails and on the train finally leaving the track, the voltage on the relay is raised to a considerable figure above the normal. The object of this is to give the relay an extra amount of lifting power momentarily, so as to ensure the armature of the relay going to its normal position in all weathers if the track is clear.

It should be noted that a track circuit is what is called a positive safety device; that is, the failure of any of its parts locks the apparatus, and shows the "occupied" signal. This happens, for instance, if a rail breaks, breaking the track circuit, or if any of the wires break; and by putting the locking and indicating battery at the relay end (a suggestion by one of my staff) any contact between the wires from this point to the signal box gives a failure indication, and locks the signal. In one case on the Midland where a track circuit was reported to have failed (showing "line occupied" when it was clear), the night was dark, and the lineman, repairing to the spot, found the track under about 2 ft. of water. This was near Swansea, and had been caused by a mountain torrent suddenly becoming very active.

The use of track circuits on the Midland Railway is now so extensive that the directors have had the whole of the passenger rolling stock electrically bonded from the tires of the Mansell wheels to the axles.

It is obvious that track circuits can be used through their relay contacts for doing all sorts of locking, indicating and signal control, and, in fact, all automatic signalling in use in this country is controlled by track circuits and their relays.

The South-Western Co., for instance, have a great many miles of four-line tracks which are automatically signalled by the electro-pneumatic system, in which the power to move the signals is supplied by low-pressure air, and the control valves which admit it and discharge it (so lowering or raising the signal) are operated by electric valves of the diaphragm type, the coils of these valves passing through the track circuit relay contacts.

The Midland Co. have put in a system of controlled automatic signalling between Steeton and Keighley and between Gargrave Hellifield, the whole being about 18 miles of track.

In this case the lines are continuously track-circuited, and the automatic signals are operated by electric motors; the motors in one section pull off the signals through an electromagnetic clutch, the power being supplied from a pair of mains run from a fairly large lead battery at one end of the section. Arrangements are made by which, when the motor has pulled off the signal, it cuts off its own current, but the current to the electromagnetic clutch continues until the train, entering the section beyond, 400 yards away, drops the track relay, when the clutch is de-energised and the signal returns to danger.

In addition to the operation or control of the signals, the signalman at each end of the section (who has no block instructions) has a large diagram which shows him automatically the state of each section between himself and the next box; that is, whether there is a train in the section or whether the line is clear.

In the section between Gargrave and Hellifield, the whole of the electrical power, whether for tracks or for operating the signal motors, is provided by a Gordon primary battery.

Very long and extensive experiments were made in our laboratory with various forms of primary batteries in order to obtain one which would give a constant E.M.F. under a steady discharge and a large capacity, which would stand a temperature of 0° F., and whose condition would be easily observed by the attendant passing through the section. No cell fulfilled these requirements so well as the Gordon cell.

In parallel with the battery of Gordon cells at any one signal post a small set of lead accumulators is placed with a capacity of, say, 20 ampere-hours, the connection from the Gordon battery to the accumulators being through small adjustable resistances so arranged that the discharge from the Gordon battery to the accumulators is just sufficient when integrated to supply energy for all the work of pulling off the signals.

When the motor is operated, therefore, the current for this comes almost entirely from the accumulators, and when the motor has finished its work, and the current is cut off, the Gordon batteries begin to supply slowly and continuously the energy which has been used.

For such a position as the Gargrave-Hellifield section (which is 7 miles long, double track) I hardly think this arrangement can be improved upon for cost of energy and cheapness of labour maintenance. Experience has shown also that it is extremely reliable.

The only efficient substitute, so far as I can see, for the ordinary "light" signal during fog (when it is invisible) is radio-telegraphy.

Some very interesting experiments have been carried out on the Midland and Stratford-on-Avon Junction railway by the Railophone Syndicate, working under Mr. Von Kramer's patents, with a view to telephoning and telegraphing from the track to a moving train.

The cost of such work is very great.

It is quite possible, however, that the cost will be considerably reduced, and in that case there should in certain circumstances be a field for such an arrangement.

In the course of a brief discussion which followed the paper, MR. ACFIELD (Signal Superintendent of the M.R.) said he thought the track circuit had come to stay. One was put down at Birmingham (not by the Midland) and failed miserably, although it was put down by experts. The track circuit on the Midland Railway had met with unbounded success, and the failures had been very few, and that, he thought, could only be attributed to the very careful design and excellent maintenance of the track circuit by Mr. Sayers. One of the largest railways in England had almost decided to adopt Mr. Sayers's design of insulated joint.

MR. CONRADIS (secretary) asked whether there would be any trouble in operating the cab-signalling apparatus with the track circuit. The Great Western system was probably the best of that type of apparatus. A commission in America which examined 400 systems, came to the conclusion that only 12 of them were worthy of notice, and the Great Western system was placed first.

In reply, the CHAIRMAN said they did not put track circuits down indiscriminately. They would not install one, say, in a goods yard where there was sand about. The rails would be kept fairly clean by the running service. As to rail film resistance, from thousands of observations from time to time he could say that it was infinitesimal, and the short-circuit was practically "dead."

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By PROF. F. G. BAILY, M.A., F.R.S.E.

(Abstract of paper read before the INSTITUTION OF ELECTRICAL ENGINEERS *at Edinburgh.)*

(Concluded from page 52.)

The oscillograph, a Duddell high-speed pattern for tracing desk and falling plate, is mounted on a table with rubber-tired trolley wheels, which carries all the accessories, and is wheeled alongside the machine to be examined.

For testing the accelerating torque of motors, a heavy fly-wheel is used, 3 ft. in diameter and 6 in. thick, made of mild steel boiler plates riveted through. It weighs 15½ cwt., and at a speed of 1,000 R.P.M. contains 4,700 ft.-tons of energy, or as much as a 10-ton car running at 15 miles per hour. It takes several minutes for a motor of 5 or 6 H.P. to take this up to speed.

Transformers are—three of 10-KW. core type by Ferranti, Ltd., made similar for three-phase combination, with the coils brought out to a connecting board for various combinations, a 10-KW. Berry transformer, 300 to 30 volts or 15 volts at 30 periods, for large currents, and some small ones. These transformers are carried on wheels for easy transport.

A high-pressure transformer is being built to give 50,000 volts, 20 K.V.A., oil immersed, but the makers have not yet succeeded in building a satisfactory machine.

For the most part wire spirals supported on small insulators set on large teak-wood frames are found to be the most convenient load resistances. All the resistances are in parallel, and each is controlled by a switch on a board below. Another convenient form is made up of thin narrow strips of fine wires woven across threads of asbestos to form broad bands, made by Schniewindt. These stand a high temperature, and cool well if fixed side by side in a frame about 1 in. apart. A large water resistance is being constructed for testing machines down to very low excitation.

The tanks are long and narrow, with electrodes of copper plate at each end. One is fixed to the end and the other is hung from a wheel which runs on a bar fixed above the tank from end to end.

The terminals being all on the fixed plates, no long flexible connections are required or any device for bringing current to the moving plates. The resistances are always intended to be used in star connection for three-phase, or in series for single-phase working, one being idle.

The salt to be used is a matter of some importance. The question of choice of liquid is now being examined.

These two forms of resistance are both necessary. Spirals or lamps connected in parallel will operate from a finite value to an infinitely large value, but not the other way. On the other hand, the water resistance operates best from a finite value to an infinitely small value.

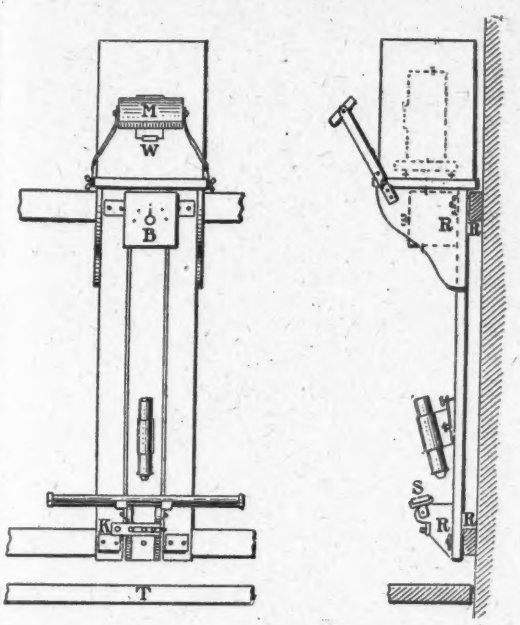
Inductive loads are provided by three large choking coils.

A portable traveller has been designed, which has proved very convenient and cheap to make, and for some purposes is invaluable.

In the test-room an equipment of standards has been laid down, including a large range of standard resistances, an excellent bridge by Nalder Bros., one of Clark Fisher's compensating potentiometers, an Oertling balance, &c.

The galvanometers are mounted overhead with scale just above the bench height, and as the mounting (fig. 3) is very cheap and satisfactory, a short description may be given. A slab of slate is supported by wooden brackets on two wooden straps, which are screwed to the wood straps round the walls with rubber washers between. Over the galvanometer is a light wooden box with a shutter which opens for use. The galvanometer in consequence does not need dusting and is very rarely moved or touched. The reflector is a strip of thin-looking glass fixed to a strip of wood

which is held out by aluminium strips fastened by screws to the reflector strip and by butterfly nuts to studs in the slate slab. To vary the distance of the mirror, the aluminium strips have several holes, which were considered better than slots, as there is no risk of the glass not been parallel to the wall. The lamp and scale are supported on a central strip of wood screwed to the straps. The scale is a paper one laid on a strip of wood, with a strip of glass over it held by metal caps at the ends. The scale can be turned round from the horizontal to suit the observer. The lamp is a 4-volt metal-filament lamp with a crinkled wire. It is set at one end of the brass tube, and at the other is a compound lens of 6½ in. focal length in a short sliding tube. The lamp-filament is



, shunt box; K, key and terminals; M, mirror; R, rubber pads; S, scale; T, table; W, window.

FIG. 9.—GALVANOMETER STAND.

focused on the galvanometer mirror, and the lens face is focused on the scale. I use, instead of the hair line or scratch, a half-circle screen with a smooth chisel edge along the diameter, which fits as a cap over the lens tube, and can be removed for cleaning the lens. This gives a half-circle of light with a very sharp straight edge, so that it is possible to enlarge with a magnifying glass and to read to fifths of a millimetre with comfort. The lenses are those used in cheap cameras, and while costing only 3s. 6d., are immensely superior to the single convex lens. The light is so good that for all ordinary work plenty of illumination can be used on the apparatus.

A standard direct-current voltmeter and ammeter are being set up, both for checking the numerous instruments in the laboratory and for the convenience of engineers in the neighbourhood. The instruments are Campbell's galvanometers—d'Arsonval galvanometers with powerful magnet, wide bifilar suspension, and moderate sensibility. Owing to the strong gravity control they are very reliable, and the only possible change is a weakening of the magnet, which can easily be checked as years go by.

The voltmeter range is obtained by a series resistance of 50,000 ohms and a universal shunt. With this single combination a range of 600 volts down to millivolts with multipliers of 3, 10, 30, 100, &c., can be obtained, with no error due to the changing resistance of the shunt of more than $\frac{1}{1000}$ part, while temperature errors are eliminated.

The ammeter is even more convenient, for owing to the sensibility the current shunts can be of low resistance. A combination of five shunts with series resistances in the galvanometer circuit gives a range from 800 amperes down to milliamperes, and the series resistance serves to swamp the temperature change of the copper coil.

The scales and steps are calibrated in the potentiometer in the first instance, and can be quickly checked at any time. A scale of 600 millimetres allows of easy reading to one part in 1,000, a sufficient accuracy for all instrument testing. The controlling resistance for the ammeter is of strip woven with asbestos, and is put on in parallel steps, from 400 amperes downwards. Each one will stand 6 volts. Fine adjustment is made on a slide resistance with a stop to prevent its short-circuiting.

The voltmeter adjustments are very simple, being merely a high-resistance and low-resistance slide in series, forming a potential slide of large range and fine adjustment.

While on the subject of instruments, I desire to make some remarks on the apparatus recently purchased. The resistances and resistance boxes have proved of exceptional merit. Not only is the agreement between the standards and the expensive bridge exact almost to the limit of identification, but several cheaper boxes and single resistances have considerably exceeded the guaranteed accuracy. This is highly satisfactory, and I mention it because the other kind of apparatus of which several examples have been obtained—galvanometers—have been most disappointing. As examples were obtained from five makers, in all cases their best quality, I am entitled to make a general complaint without mentioning names. The design in one respect or another is characterised by error or inconveniences which argue a lack of knowledge of the habitual use of the instrument. For example, one galvanometer is accessible only at the back, and as these instruments are usually placed against a wall, it is necessary to shift the instrument to find out if the adjustment is out of order. In another it was quite impossible to examine the coil when in position, as the cover carried the whole coil support. I should add that since the purchase of this one, the makers have altered the design, so that the cover can be completely removed. One maker was using copper with a magnetic constituent, which gave a shift of zero of 7 per cent. according as the deflection was to the right or the left. Two of them used methods of insulation in which barely $\frac{1}{32}$ in. surface of rough ebonite was considered satisfactory, and a third did not insulate from the case at all, and trusted to ebonite feet, which means that one dare not touch the galvanometer unless the battery is cut off at both poles, and the dust and sunlight have free access to the insulating material. In another case the windows of the case all dropped out as soon as they were touched for dusting. They had been stuck on with seccotine.

In one a quartz fibre was supposed to be used of a size which had a breaking strain slightly less than the weight of the parts suspended. Needless to say, the actual fibre was three times as thick and consequently exerted 80 times the controlling force. The actual fibre spoilt the galvanometer for its ostensible sensitiveness.

The most absurd blunder was that of an instrument to read over a definite range and angle. The correct range had been most carefully adjusted, but the window was so restricted that the beam of light was cut off through the first and last quarters.

There seems to be a mania for making galvanometers of the highest sensibility small and elegant, regardless of accessibility, as if they were portable instruments or drawing room ornaments; or else some small economy of manufacture is introduced with no regard to its evil effects on the galvanometer as a scientific instrument.

Absolutely none of these instruments were of special design to unusual requirements. They were all taken straight out of catalogues. Hence I really think that some dissatisfaction is permissible after all these years of experience. I believe that Mr. Sullivan's well-known galvanometers are almost the only ones I have bought in recent years that are thoroughly convenient and pleasant to use. They are roomy, visible, and accessible, and though they are, or were, expensive, many of their good points could be obtained at a trifling cost.

While discussing galvanometers, I should like to raise the question why galvanometers which are used as direct-reading voltmeters, should not be wound with some alloy with low-temperature coefficient and moderate specific resistance. No galvanometer coil ever gets hot from its normal current, so that there is not that reason for putting the swamping resistance outside, while a greater freedom from temperature errors might be obtained by avoiding the use of copper.

The photometer-room has no great novelties. The inexpensive character of the benches is perhaps its chief point.

A museum has been fitted with cases for the display of parts of machines, accumulator plates, &c. On account of limited space the show cases also serve as drawing benches. This is a convenient combination, as examples of parts and drawings are just the equipment required for a drawing office.

The lighting is effected with glow lamps using inverted conical opal shades below and clear glass conical shades above, making a double cone with the lamp along the axis. A subdued light comes down direct, but most goes to the ceiling, and the result is a practically shadowless illumination, although it is certainly more extravagant than direct lighting.

I have put down a complete workshop, containing a small shaper and miller, a 5-in. lathe and a 3½-in. lathe, both fully equipped, a pillar drilling machine, emery grinder and buff, grindstone, all being power driven, with fitter's bench, carpenter's bench, instrument maker's bench, plate shears, and spare table for erecting, together with stores of every size and shape and kind of screws, bolts, nuts, washers, terminals, "wireman's sundries," rod, tube, sheet strip, and wire in all required material and sizes. A large equipment of this kind is of incalculable convenience. The shop is not intended for teaching students.

Each machine is driven from a small magnetic clutch in the main shaft actuated by a pear switch hanging by its machine, while the driller is operated by the foot with a bell-push on the floor. I am about to fit a pear switch and a floor-push in parallel on several machines, to give continuous running with one and intermittent running with the other without using a hand.

Each clutch takes from 5 to 7 watts, according to size of ¼ or 1 H.P. They start and stop instantly, having, by kind permission of Electric Clutches, Ltd., their contrivance of a loose disk of thin hard steel between the magnet and the keeper. This is completely effective, eliminating any jerk at starting, and introducing sufficient demagnetising surfaces to produce instant release.

As far as possible the fittings, apparatus and machinery of ordinary commerce have been utilised. Not only is this the cheapest course, but the equipment forms a large demonstration of many kinds of useful objects. Even at some slight sacrifice to convenience, I have used the patterns of as many different makers as possible.

ELECTRIC POWER FOR THE PANAMA CANAL.—I.

By JOHN GEO. LEIGH.

(*Continued from page* 46.)

As stated in an earlier article, the hydro-electric station at Gatun briefly referred to above is intended to furnish power to operate the gates, valves and other machinery of the locks, the regulating works of the spillways of Gatun and Miraflores dams, and generally to provide power and light throughout the canal line. With its completion and that of the constructional work on the Atlantic side of the Isthmus, for which it now furnishes power, the existing steam-operated station at Gatun will be no longer required. The Miraflores power house, with its present equipment, will, however, be retained as a reserve generating station, connected with the station at Gatun spillway by a transmission line, with the result that current from either, or both, can be used for any of the operations of the canal.

In the advertisement inviting tenders for the equipment of the new power station, bids were requested on two proposals, one for a plant to be installed a short distance below the spillway dam, and a second for an installation in a position further north, the advantage of the latter situation being, of course, the greater head obtainable. For proposal No. 1, the average difference between the water levels in the lake and in the tailrace was estimated at 75 ft.; and the turbines, necessarily of the vertical type, were rated on this basis. In the event, however, of the adoption of the second proposal, turbines of either horizontal or vertical type would have been admissible, and were rated on the basis of an average difference of 83 ft. in elevations.

The three turbines called for in the circular inviting tenders will be of the unsubmerged vertical shaft type, with runners uncased and in tandem, not more than two per turbine. Each will have a speed of 300, 250, or 214·3 R.P.M., as may be best adapted to the design, must be capable of delivering 2,250 KW. at the shaft, and be subject, in operation, to instantaneous fluctuations of load equal to 50 per cent. of the full rating. The runners are to be of cast-iron or steel plate, or a combination of both, designed to give the blades maximum strength and rigidity, and to be so arranged as to be easily removable from the case, and to withstand all shock occasioned by water-hammer and an increase in speed of 100 per cent. above normal. The outer casing will be of either cast-iron or steel plate, and the inner casing of cast-iron, every facility being provided for the inspection, repair and removal of the runners. The shaft will be of hollow cross-section, and of forged nickel or carbon steel, preferably the former. A vertical thrust bearing of the hanging, ball or roller type is specified for the main bearing, and the speed regulating gates are to be of the balanced wicket type. Each turbine will be provided with quick-acting relay type governors, actuated electrically or hydraulically, and of capacity to operate the gates in such time as will give the minimum variation in turbine speed. Each governor also, in view of possible failure to operate, will be equipped with an auxiliary device for smoothly closing the gate.

The generators will be of the three-phase alternating type, capacity 2,500 K.V.A. (2,000 KW.) at 80 per cent. power factor; poles, 10, 12 or 14; voltage (delta), 2,200; current per phase, 656 amperes; frequency, 25 cycles per second; and speed 300, 250 or 214·3 R.P.M. They will be of the vertical, water-turbine type, with separately excited revolving field; armatures star-connected, and the neutral lead to be brought to the same terminal block as the phase leads. Provision must be made for the operation of the generators in parallel, either with one another or with the installation of three 1,500-K.V.A., 2,200-volt, 1,500 R.P.M., 25-cycle, star-connected, steam turbine-driven alternators, at Miraflores, 40 miles distant, by transmission from Gatun spillway. Owing, moreover, to the fact that they will be subjected to instantaneous fluctuations of an extreme nature—consequent upon the starting and stopping of the many induction motors required in the operation of the several locks—the generators must be designed to meet the conditions of an instantaneous variation of load equal to 50 per cent. of the full load rating. Mounted directly on the shaft of each will be an exciter generator of the direct-current, shunt-wound type, 50 KW., 125 volts and 400 amperes.

The inside diameter of the penstocks, which will be of the combination metal plate and concrete type, will be not less than 10 ft. 6 in. The plates, of wrought-iron or soft steel, are to be not less than $\frac{5}{8}$ in. thick, and will be united in a continuous tube from gates to turbines, either by riveting or lockbar joints. To close the entrance to each penstock a headgate will be required. This will be constructed entirely of iron and steel, run in cast-iron or steel guides, and be raised or lowered by means of a vertical stem. To the stem motion will be transmitted by a vertical, non-rising worm, driven by a 220-volt three-phase induction motor. Each gate will be provided with an auxiliary valve for the purpose of passing water slowly into the penstock, and filling it in approximately five minutes, after periods of shut-down or disuse of the turbines. In front of the gates there will be, of course, the usual trash-rack of bar iron to protect the gates, penstock and turbine from damage by timber or other *débris* carried in the water.

The project also provided that in a basement floor of the power house under the generator room there would be placed compressed-air regulators, or surge tanks, of the differential type. Under this scheme there would have been one regulator attached to each penstock, a common header connected to a compressed-air tank, two air compressors, and the necessary auxiliaries. The regulator, in addition to acting as a buffer for shocks, due to rejected loads, was intended to assist the governor in adjusting the turbine speed. It would have been constructed of steel plates, been air-tight, and riveted to the penstock through a tapering nozzle of proportions calculated to give the best results in speed regulation.

Consideration of the tenders received in response to their circular has induced the Canal Commission to sanction several modifications of the installation to which reference has been made. Three tenders, I am advised, came to hand in respect of turbines, and the same number were submitted for the supply of generators, and these permitted of eight different combinations. Of the latter, that including the plans of the Pelton Water Wheel Co., of San Francisco, and of the General Electric Co., of Schenectady, N.Y., was considered most advantageous and, accordingly, contracts with these firms for, respectively, turbines and generators, have been authorised. At the same time, it was resolved definitely that the site proposed for the power house quite adjacent to the spillway dam should be adopted, in preference to that further north, where an additional head of 10 per cent. might be obtained. Two reasons are given for this decision—first, the consideration that even in exceptionally dry seasons there will be more water available in the lake, or summit level, than will be required for all the lockages that time will permit; and secondly, an economy of between £20,000 and £40,000.

In the tender accepted, the Pelton Water Wheel Co. undertakes to furnish for $85,000 the three water turbines, three governors, three headgates, three penstocks, three compressed-air regulators and the lubricating system specified in the Commission's circular. It further guarantees satisfactory regulation without surge tanks, and, if these machines are installed, recommends the omission of the proposed regulating system. The General Electric Co., it is equally interesting to note, has undertaken to supply three generators, 250 R.P.M., weight 116,200 lb.; three exciters of 50 KW. capacity, and two motor-driven exciter sets of 100 KW. capacity, for $54,534. Due to the fact that in this type of generator the bearing for the rotating parts is placed on the top of the generator case, it will be possible to dispense with the mezzanine floor in the power house.

Work on the project for lighting and buoying the canal dates from April last, and is advancing rapidly in accordance with a time schedule. The scheme is based upon a study of the subject by an officer of the Lighthouse Board at Washington, who has since been detailed to superintend the arrangements, and has also, at the request of the Government of Panama, submitted a report regarding the placing of lights

and other aids to navigation in Panama Bay, to assist vessels seeking the port of Panama and the Pacific entrance to the canal. In the canal proper, there will be side lights, placed about a mile apart, to mark each side of the channel; range lights—elsewhere than in the Culebra Cut, where their use is hardly practicable—to establish direction in the longer tangents; a light and fog signal on the west breakwater in Limon Bay; a light on the east breakwater, should it be built; and gas and sun buoys marking the channel to the Mount Hope dry dock. For the lighted buoys in all sections of the canal and the beacons in Gatun Lake, acetylene gas will be used; but for the beacons in the Atlantic, Pacific, Miraflores and Culebra sections, electricity will be the illuminant.

At each tangent two ranges of two lights each are needed to prolong the sailing line, in order that the pilot may hold his course up to the point of turning. The range lights are placed upon land, and it has been necessary to cut trocha, or paths, through jungle and forest, frequently very dense, until suitable positions are found, providing an unrestricted view of the range and reference targets. These trocha are the width of the canal at their beginning, and narrow to about 400 ft. at the end. Surveying parties, of 10 men each, run the lines, and then the clearing gangs, numbering from 50 to 100 men, are set to work. The result of these operations up to November 1st is indicated in the following table :—

	Acres cleared.	Trocha cut. Feet.	Profile taken. Feet.	Line run. Feet.
April ...	51·0	—	—	—
May ...	145·5	64,825	10,200	—
June ...	177·0	57,350	6,000	—
July ...	146·2	50,720	28,869	—
August ...	133·0	45,040	4,478	73,000
September ...	80·5	42,200	17,226	17,300
October ...	104·0	60,450	—	—
	837·2	320,685	66,773	90,300

There remain to be cleared about 200 acres, the largest area claiming attention being that at the Frijoles tangent on the range line for north-bound ships. The range towers

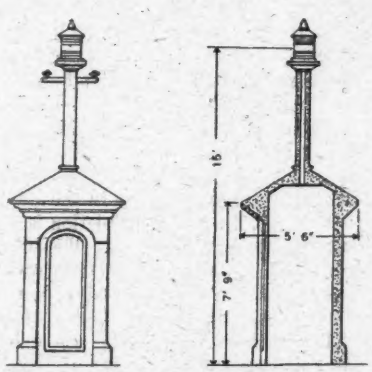


FIG. 3.—BEACON FOR CULEBRA CUT AND GATUN LAKE.

are of two types, one plain, and the other, to be used in positions near the channel, comparatively ornate, and vary in height from base to focal plane from 29 ft. to 74½ ft. The tower illustrated in fig. 4 is one of the highest of the ornate type, and is 16½ ft. in diameter at base and 7½ ft. diameter at focal plane. The beacons, of which an illustration is given above, are 15 ft. high from base to focal plane, 5½ ft. square at cornice of roof, and 4 ft. square below roof. Like the towers, they are constructed of reinforced concrete, and are surmounted by a column of the same material—outside diameter 8 in., inside 3 in.—which will support the lens.

Gas buoys, consisting of a cylindrical floating body, or tank, surmounted by a steel frame, supporting a lens about 15 ft. above the water level, will be moored in positions along the edge of the dredged channels. These, it is estimated, will remain lighted from six to twelve months without being recharged. The candle-power of the range lights will vary according to the length of the range, from 2,500 to 15,000, the most powerful lights being those marking the sea channels in the Atlantic and Pacific entrances. These will be visible from about 12·5 to 18 nautical miles. The beacons and gas buoy lights will be of about 950 C.P. To assist identification, all the lights, range, beacon, and buoys, will have individual characteristics, formed by flashes and combinations of flashes of light and dark intervals. According to present arrangements, there will be constructed and placed in position 34 range towers, 57 beacons, 57 gas buoys, 76 spar buoys and 7 sun buoys.

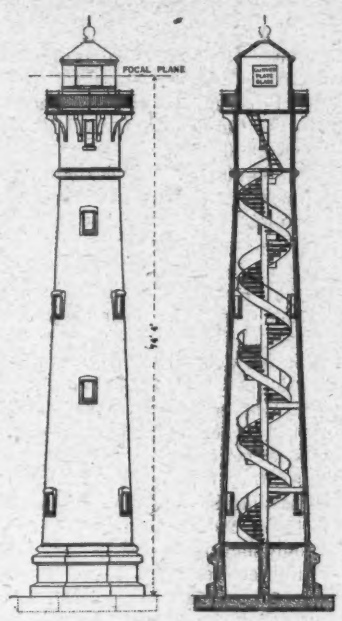


FIG. 4.—RANGE TOWER.

About £136,000 is the estimated cost of all the structures and aids to navigation—other than the floating plant to be derived from the existing construction equipment of the canal—involved in the foregoing scheme; and the annual maintenance charge of the system, when in full operation, is not expected to exceed £12,500.

ELECTRICAL DEVELOPMENT IN INDUSTRIAL AREAS.

BY L. CROUCH.

(*Concluded from page* 76.)

Great Industrial Centres.—Considering a group of seven great industrial centres, the average population per town rises to 974,300, of which as many as 2·3 per cent. are electrical consumers. The mean area of electricity supply per town is about 50 sq. miles, the consumer density being 455 per sq. mile. A total of 470,000 KW. generator capacity supplies 1·20 times as great a connected load (excluding traction), and 0·64 times as great a maximum load. The total sales per annum approximate 211 million units for traction and 427 million units for other purposes. The consumer density reaches the highest value attained in any of the present groups, but though the connections and annual consumption per head of population are high, the corresponding figures on a consumer basis are not exceptional. The sales per annum per head of population, for traction and for other purposes, are nearly double the corresponding sales realised in the group of inland towns or in the group of ports.

The load factor averages 21·2 per cent.—the highest mean value here obtained. The highest individual load factor in the "Industrial Centres" group is 24·2 per cent. for Manchester. Yet higher figures in other towns are :—34·4 per cent. for West Ham; 32·8 per cent. for Stalybridge; and 27·1 per cent. for Prescot.

Private motors show extraordinary development as regards total horse-power in use (this averaging 33,700 H.P. per town), but its percentage relation to the total connections is normal (31 per cent.). The average horse-power per private

motor is 9·3 H.P. or 1·48 H.P. per consumer (the latter figure should be capable of considerable improvement). The traction motor horse-power is practically equal, in total amount, to that of the private motors.

Textile Towns.—Thirty towns in all are considered, 17 being mainly engaged in cotton and 13 chiefly in woollen manufactures (Cols. 5 and 6, Tables II, III, IV). The average population per town is 154,000 in the cotton and 110,000 in the woollen centres. The corresponding average areas of supply are 21 and 17 sq. miles. The total generator capacity of 105,000 KW. in the cotton towns (6,150 KW. per town) supplies 139,300 KW. of connected load (excluding traction) and 80,300 KW. of maximum demand. In the woollen centres 50,000 KW. generator capacity (3,840 KW. per town) supplies 76,500 KW. of connected load and 33,100 KW. maximum load. For the cotton and woollen groups respectively: connected load per generator capacity = 1·32 and 1·52, and maximum load per generator capacity = 0·76 and 0·66. The maximum load per consumer in the cotton towns (2·72 KW.) is nearly double the corresponding figure for the woollen group, though the percentage of consumers is 1·56 per cent. of the total population in the latter, as against 1·14 per cent. in the former case. The consumer density is 10 per cent. higher in the cotton group, and the annual sales per consumer averages 5,100 B.T.U., as against 2,500 B.T.U. in the woollen centres. The former figure is the highest attained in any of the present groups, and the load factor of 20·6 per cent. in the cotton manufacturing towns is only slightly lower than the average figure for the great industrial centres.

Private motor connections average 4,600 H.P. per town in the cotton group as compared with 2,660 H.P. in the woollen centres, but, as a percentage of the total non-traction connections, the motor development is nearly equal in the two groups (37·0 per cent. and 34·0 per cent.). The horse-power of traction motors and the annual traction sales are nearly twice as great in the cotton as in the woollen towns. The average horse-power of private motors is also greater in the former, being 8 H.P. as against 5·6 H.P.; the corresponding horse-powers per consumer are 2·3 and 1·6 H.P. respectively.

Cheaper power is obtainable in the cotton than in the woollen centres, but the relative cost, as compared with the price obtained for "all purposes," is practically the same in each case.

Iron-making Towns.—Under this heading are included 15 towns, averaging 93,000 population and about 7 sq. miles supply area. The connected load and the maximum load average respectively 1·50 and 0·70 times the generator capacity, which totals 41,500 KW., *i.e.*, 2,770 KW. per town. An average of 1·25 per cent. of the population are electrical consumers (160 per square mile of supply area), and the connections and maximum demand per consumer are, respectively, 3·15 and 1·50 KW. The average sales per consumer per annum (excluding traction sales, which amount to, roughly, one-third of the total) equals 2,350 KW. About 3,700 private motors are in use, averaging 7·7 H.P. per machine, 2 H.P. per consumer and 2,300 H.P. per town; the total horse-power of traction motors is over half as great. The mean load factor of undertakings in this group is 19 per cent.

Shipbuilding Centres.—The average population in the eight towns considered, omitting London for the reasons already stated, is 275,000, of which number about 1·3 per cent. represent electrical consumers. The average supply area being 12 sq. miles, the consumer density is approximately 300 per sq. mile. The connected and maximum loads are low as compared with the generator capacity (113,200 KW. per 10,300 KW. per town), being respectively 1·22 and 0·58 times the latter. The connected and maximum loads per consumer average 3·6 and 1·7 KW., and the average annual consumption per consumer is 2,900 units, excluding traction sales. Private motors, to a total number of close on 9,000, average 8,200 H.P. per town, 6·6 H.P. per machine, and 2·4 H.P. per consumer. The latter figure is exceptionally high, and in this group the private motor connections average 48·8 per cent. of the total connections. An average load factor of 19 per cent. is realised.

Miscellaneous Manufactures.—In columns 9, 10 and 11 of Tables II, III and IV are included data concerning groups of towns respectively engaged in:—

(*a*) The manufacture of miscellaneous machinery.

(*b*) The manufacture of metal goods, other than machinery.

(*c*) General manufactures, including pottery, porcelain, glass, linen, silk, lace, carpets, straw, gloves, leather, salt, chemicals and brewing. This group may be regarded as a typical selection of miscellaneous manufacturing towns of small and medium size. Though the average population per town is greater than in Column 1, the fact that many of the largest provincial cities do not come under any of the manufacturing heads here considered, prevents the elimination of the "country" towns having as great an effect on such items as the "per cent. consumers," "H.P. per consumer," &c., as might be anticipated.

Treating each group in turn along the general lines already adopted:—

(*a*) *Machinery Manufactures.*—Thirteen towns average 133,000 population, the percentage of electrical consumers being nearly 1 per cent., distributed over the supply area, which averages 15·5 sq. miles, in the proportion of about 87 consumers per sq. mile. The mean connections and maximum demand per consumer are high (4·4 and 2·0 KW.), but the ratios of total connections and maximum demand to the generator capacity are normal (1·5 and 0·68). The annual sales per consumer for non-traction purposes average 2,600 B.T.U., and the traction sales are roughly one-quarter of the total for all purposes. A low private motor development may be noted (29·1 per cent. of the connected load); the average horse-power per town is 2,510, per machine is 10·4, and per consumer is 1·68 H.P. From these figures it will be seen that towns of this class still offer a wide field for comparatively large motors.

(*b*) *Metal Manufactures.*—Here again nearly 1 per cent. (of an average population of 187,500 in eight towns), are electrical consumers, and a consumer density of about 160 per sq. mile is reached. A generator capacity of some 47,000 KW. supplies 69,200 KW. of connected load and 30,000 KW. maximum demand. The connected load consumer averages 4·8 KW., and the corresponding maximum demand is 2·6 KW. (average load factor = 19·1 per cent.). The annual sales per consumer averages 3,500 B.T.U., and of the total sales, 38 per cent. is for traction purposes. Nevertheless, an exceptionally high private motor H.P. per consumer (2·9 H.P.), is averaged, and the private motor connections = 45·1 per cent. of the total (this high figure is largely due to the Birmingham data). The average H.P. per private motor in this group is 8·8 H.P.

(*c*) *Miscellaneous Manufactures.*—In the 42 towns considered in this group, the mean population is 110,800 and the average supply area 8·25 sq. miles. The total generator capacity (118,150 KW. or 2,815 KW. per town), supplies 1·48 times as great a connected load and 0·73 times as great a maximum demand; the average load factor is 18·5 per cent. The number of electrical consumers averages 1·16 per cent. of the population, and the connected and maximum loads per consumer average 3·24 KW. and 1·60 KW. respectively. The annual consumption per consumer (for non-traction purposes) is 2,200 B.T.U. Among 8,630 private motors, the mean horse-power per machine is 6·7 H.P. and per consumer is 1·29 H.P. The private and traction motor loads are nearly equal (at about 1,800 H.P. per town or 30 per cent. of the total connections), and the annual traction sales are roughly one-third of the total for all purposes.

Conclusions.—No such treatment as the present can be complete, since so large a portion of the fundamental data required is inaccessible if, indeed, existent. Yet greater are the difficulties to be faced when seeking a *comparison* of the electrical development attained in various groups of towns. In such a case, the very bases of comparison are largely indeterminate, and there is obviously no definable connection between the conditions and results existing in various towns. Table IV, however, collects sundry data from Tables II and III, whence we may make the following observations. The weight to be attached to these, and other conclusions drawn from the same source, depends essentially upon the particular object in view and its relation to various factors which cannot directly be taken into account.

The number of towns considered in each group is obviously connected with the validity of the various averages deduced, though here again the averages deduced for the

seven "Industrial Centres" (Column 4) are undoubtedly more significant than the corresponding figures for the 42 miscellaneous manufacturing towns treated in Column 11. Accuracy of classification for the object in view, and similarity of conditions from the standpoint assumed, are of the utmost importance in determining the value of the results.

Population, supply area and number of consumers are, of course, inter-connected, though according to no simple law. The nature of the industries carried on in the various areas, the geographical circumstances of the latter, and the wealth or poverty of the inhabitants, are only a few of the factors determining the result. We wish to observe the effect of variations in as many as possible of these factors, but only too many, even of those closely dependent on industrial conditions, are greatly distorted by irrelevant local circumstances, or inter-connected with more or less pertinent matters, in so complex a manner as to render hopeless any attempt at a really detailed analysis.

The number of consumers as a percentage of the total population naturally reaches a maximum in the "industrial centres" group (2·3 per cent.), where also the maximum consumer density (455 per sq. mile of supply area) is to be found. The corresponding figures for the 80 "inland towns," dealt with in Column 1, are approximately 1·5 per cent. and 220 per sq. mile.

The mean generator capacity per town is far greater in the industrial centres and ports than in any other cases treated. The total connections, excluding traction, range from 1·2 to 1·5 KW. per KW. of generator capacity (to allow for the total H.P. of traction motors in service, these limits must be increased by 20-50 per cent.—see Table III). From 0·58 to 0·76 KW. of maximum demand is supplied per 1·00 KW. generator capacity, the highest values of this ratio (*i.e.*, the most complete utilisation of generator capacity) being found in the group of cotton manufacturing towns. Closely allied to these factors is the load factor, the average value of which ranges from 17·5 per cent. to 21 per cent., being a maximum in the industrial centres and a minimum in the inland towns.

The connected load per head of population reaches its maximum value (0·083 KW.) in the industrial centres group, but the mean connections per consumer are considerably higher (4·8 KW.) in the cotton than in the industrial centres group (3·5 KW.), where, however, the percentage of consumers is higher.

Per head of population, the total annual sales for all purposes is 44·5 B.T.U. in the average inland town, and reaches its maximum value of about 94 B.T.U. in the industrial centres group. Of this total, from 24 per cent. in the miscellaneous manufacturing towns up to 40 per cent. in the inland towns is required for traction purposes. In the great industrial centres about one-third of the total sales goes to the tramway load. The traction motor horse-power installed, as a percentage of the private motor connections, ranges from 46 per cent. in the miscellaneous metal manufacturing towns (total sales per head of population, 54 B.T.U. per annum), to 129 per cent. in the cotton group; the corresponding figure for the woollen towns is 73 per cent.

As a percentage of the total non-traction connections, private motors range from 29 per cent. in the miscellaneous machinery group to 46·5 per cent. in the iron-making centres, and 48·8 per cent. in the shipbuilding towns. In the "inland towns" group this percentage is 36·5 per cent., falling to 31·5 per cent. in the "industrial centres."

The industrial centres have by far the greatest total H.P. of private motors per town, but the highest average H.P. per individual motor is attained in the miscellaneous machinery group (10·4 H.P., as against 7·2 H.P. in the inland towns, 8·6 H.P. in the ports and 9·3 H.P. in the industrial centres). The motor H.P. per consumer varies from 1·5 H.P. in the ports and industrial centres, to 2·3 H.P. in the cotton and shipbuilding groups, and 2·9 H.P. in the miscellaneous metal manufacturing towns.

The average price quoted for electricity supply for power purposes in the various groups of towns ranges from 1·36d. per B.T.U. in the iron-making centres to 1·83d. per B.T.U. in the woollen group. The corresponding mean of the power tariffs in 390 supply districts being 2·0d. per B.T.U., it will be seen that the above limiting figures are respectively 68 per cent. and 92 per cent. of the average for the whole country.

To attempt the determination of an order of development from the criteria given in Table IV could only arouse controversy. The reader will at once see which groups show maximum development as judged by various standards (different standards yielding a different order of merit), and which groups show possibilities of further development in these or other directions.

In a mass of figures gleaned from many sources, discrepancies almost inevitably appear, but the writer trusts that any found herein are attributable to no more serious cause than differences in the number of towns on which various averages are based (in cases where incomplete data are available).

TRADE STATISTICS OF PERU.

THE following figures, showing the imports of electrical and similar goods into Peru during the year 1909, are taken from the recently issued official trade statistics. The figures for 1908 are added for purposes of comparison, and notes of any increases or decreases are given :—

	1908.	1909.	Increase or decrease.
	£	£	£
Scientific instruments and apparatus.—			
From Germany	3,000	4,000	+ 1,000
„ France	3,000	1,000	— 2,000
„ Great Britain ...	2,000	2,000	—
„ Belgium	1,000	2,000	+ 1,000
„ Other countries ...	1,000	1,000	—
Total ...	10,000	10,000	—
Telegraph and telephone instruments and apparatus.—			
From Germany	800	800	—
„ United States ...	2,000	1,300	— 700
„ Great Britain ...	100	100	—
„ Other countries ...	100	100	—
Total ...	3,000	2,300	— 700
Machinery, other than printing machines, motors, pumps, &c.—			
From Germany	20,000	14,000	— 6,000
„ Belgium	2,000	2,000	—
„ United States ...	98,000	22,000	— 76,000
„ Great Britain ...	10,000	15,000	+ 5,000
„ Other countries ...	6,000	3,000	— 3,000
Total ...	136,000	56,000	— 80,000
Iron wire.—			
From Germany	2,100	1,300	— 800
„ United States ...	2,100	2,400	+ 300
„ Great Britain ...	2,600	2,400	— 200
„ Other countries ...	2,700	700	— 2,000
Total ...	9,500	6,800	— 2,700
Rails.—			
From Belgium	7,000	17,000	+ 10,000
„ United States ...	191,000	35,000	—156,000
„ Great Britain ...	8,000	4,000	— 4,000
„ Other countries ...	1,000	—	— 1,000
Total ...	207,000	56,000	—151,000
Railway material.—			
From Germany	7,000	—	— 7,000
„ Belgium	23,000	35,000	+ 12,000
„ United States ...	51,000	16,000	— 35,000
„ Great Britain ...	6,000	4,000	— 2,000
„ Other countries ...	2,000	—	— 2,000
Total ...	89,000	55,000	— 34,000
Coal.—			
From Germany	18,000	6,000	— 12,000
„ Australia	99,000	23,000	— 76,000
„ United States ...	9,000	9,000	—
„ Great Britain ...	239,000	152,000	— 87,000
„ Other countries ...	22,000	4,000	— 18,000
Total ...	387,000	194,000	—193,000

	1908.	1909.	Increase or decrease.
	£	£	£
Pumps, motors, &c. (includes electric motors).—			
From Germany	13,000	6,000	— 7,000
„ Belgium	3,000	2,000	— 1,000
„ United States ...	92,000	38,000	— 54,000
„ Great Britain ...	41,000	61,000	+ 20,000
„ Other countries ...	2,000	3,000	+ 1,000
Total ...	151,000	110,000	— 41,000

The following details are available for goods further sub-divided, but full details as to the countries from which they are imported can be given. Reference to the above figures will, however, give some indication :—

Morse telegraph apparatus	58	121	+ 63
Ditto, without clockwork...	110	111	+ 1
Electric bells	126	88	— 38
Galvanometers	26	34	+ 8
Telephones	1,083	285	— 798
Motors of all kinds—steam, electric, hydraulic, &c. ...	128,000	87,000	— 41,000
Meters and regulators for electric light	393	166	— 227
Parts of motors, &c. ...	9,000	13,000	+ 4,000
Armoured cables of copper	16	10	— 6
Flexible cords covered with cotton, wool, &c.... ...	1,053	1,318	+ 265
Ditto, covered with silk ...	56	26	— 30
Arc lamps	399	384	— 15
Incandescent lamps ...	3,592	4,062	+ 470

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

AMENDMENTS.

FRANCE.—The French Customs Authorities have decided that drums for steam turbines of iron or steel shall be dutiable as "detached parts of machines," if in the rough state or trimmed, at rates varying from 8 fr. per 100 kg. for heavy goods to 20 fr. per 100 kg. for light goods. If in the worked state, these drums are to be dutiable as "parts of turbines driven by steam, gas, petrol, or any other gaseous or explosive mixture" at the rate of 30 fr. per 100 kg. if weighing 200 kg. or more and 40 fr. per 100 kg. if weighing less than 200 kg.

AUSTRALIA.—With reference to the previous notice in the ELECTRICAL REVIEW regarding Australian revision of duties on electrical goods, it is to be noted that further important amendments have now been made. The chief of these is that in future preferential treatment will be given to certain British electrical machines. Formerly, British machines were dutiable at the same rates as foreign, but for the future the following discrimination will be made :—

	Rate for British goods.	Rate for foreign goods.
Dynamo-electric machines up to the capacity of 200 H.P.; static transformers and induction coils for all purposes; electric fans	20 per cent.	25 per cent.
Dynamo-electric machines over the capacity of 200 H.P. ...	12½ „	17½ „

The following decisions as to the duties to be applied to certain electrical and similar goods have also been published :—

Contact breakers, Telewriter	10 per cent.
Gas machine, Simpitrol, System C	20 „
Centrifuge, electrical, including motor which is an integral part thereof (used in cream testing) ...	Free
Motor-car lamps, electric (head, side or rear, similar to ordinary gas or oil lamps but illumined by an electric filament lamp)	15 per cent.

NOTE.—The rates quoted are in all cases those leviable under the British Preferential Tariff.

NEW ZEALAND.—The Customs authorities have decided that electric cables in sets, with terminals affixed, enclosed in flexible tube are to be dutiable at the rate of 20 per cent. *ad val.* if of British origin, and at the rate of 30 per cent. *ad val.* if of foreign origin.

BOLIVIA.—The Board of Trade have been informed by telegraph from Bolivia that from January 1st, 1912, the duties formerly leviable on all goods imported into that country have been increased by 15 per cent.

NEW PATENTS APPLIED FOR, 1912.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

20. "Battery lamp for miners and the like." J. MASON. January 1st.
28. "Primary batteries." H. E. FRY. January 1st.
30. "Electrical switches and fuses combined." R. W. BILL. January 1st.
32. "Means for and methods of charging and discharging electric accumulators or secondary batteries." A. M. TAYLOR. (Addition to 20,906/1910.) January 1st.
37. "Starting means for vapour electric devices." F. CONRAD. (Convention date, January 7th, 1911, United States.) January 1st. (Complete.)
38. "Electrical terminal devices." Y. SAKAI. (Convention date, January 7th, 1911, United States.) January 1st. (Complete.)
44. "Dynamo-electric machines of the homopolar type." F. H. LORING. January 1st.
71. "Storage battery lamps." C. B. BARTLEY. January 1st.
81. "Joint for the metallic coverings of insulated electric wires." F. J. WHITING. January 1st.
86. "Wireless telegraph receivers." G. MARCONI and C. S. FRANKLIN. January 1st. (Complete.)
88. "Electric switches and circuits." G. H. BATLEY and J. M. BEIN. January 1st. (Complete.)
120. "Memorandum and like appliances for use in connection with telephones and other purposes." E. F. M. BRANSON and F. H. BOWDEN (trading as Branson & Bowden). January 2nd.
129. "Electric safety lamps." H. J. DEAN. January 2nd.
140. "Apparatus for heating water by electricity." J. SHANKS and J. A. G. SHANKS. January 2nd.
141. "Heating elements for electric radiators and for other purposes." J. SHANKS and J. A. G. SHANKS. January 2nd.
148. "Automatic signalling on electric tramways." L. C. PARTINGTON. January 2nd.
160. "Controlling device for electric circuits." R. H. HUTCHINSON and F. WILKINS & BRO., LTD. January 2nd.
163. "Mechanical connectors for electric cables." F. NEAVE and CALLENDER'S CABLE AND CONSTRUCTION CO., LTD. January 2nd.
181. "Electric batteries." P. L. LINEY. January 2nd.
183. "Vapour electric apparatus." P. C. HEWITT. (Convention date, January 3rd, 1911, United States.) January 2nd. (Complete.)
190. "Electrically-operated telphers and tracks therefor." R. P. STRACHAN and STRACHAN & HENSHAW, LTD. January 2nd.
192. "System of alternating magnetic flux applicable to magneto electric machines and to alternate current machines." SOC. D'ELECTRICITE "NILMELIOR." (Addition to 22,053, 1911. Convention date, June 8th, 1911, France.) January 2nd. (Complete.)
198. "Electric indicating instruments." THE BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) January 2nd.
229. "Illuminated signs for use with arc lamps." W. J. BEVILLE. January 3rd.
249. "Registering and recording mechanism for electric meters or the like." C. I. HALL. (Convention date, January 3rd, 1911, United States.) January 3rd. (Complete.)
285. "Electric connecting plugs." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) January 3rd.
290. "Automatic instantaneous switches for alternating and direct-current circuits." A. M. TAYLOR. January 4th. (Addition to No. 7,041/1910.) January 4th.
315. "Fusible cut-outs." C. M. DORMAN and A. R. SMITH and H. G. BAGGS. January 4th. (Complete.)
330. "Oil immersed electrical switches and circuit breakers." H. R. SCHULTZ. January 4th.
334. "Telephone appliances." V. D. EVANS. January 4th.
335. "Telephone hearing appliances." V. D. EVANS. January 4th.
341. "Construction of secondary batteries." H. LEITNER. January 4th.
346. "Adjustable inductance coils." R. A. FESSENDEN. (Divided application on No. 2,617 of 1911, February 1st. Convention date, February 2nd, 1910, United States.) January 4th. (Complete).
374. "Methods of obtaining continuous currents from alternating current circuits." A. M. TAYLOR. (Addition to No. 20,867 of 1909.) January 4th.
375. "Ignition spark detector for internal combustion engines." R. G. MOSELEY. January 4th.
378. "Adapter for converting ordinary socket electric conduit fittings into grip continuity electric conduit fittings." H. A. WILKES. January 5th.
387. "Electric heating elements." E. TOWNSHEND. January 5th.
392. "Electric lighting switch lock." V. E. WHALLEY. January 5th.
416. "Telephone receiver holder." H. BROWN. January 5th.
491. "Anti-vibration suspension device, applicable for electric lamps." A. W. SPARKES. January 6th.
523. "Electric controller regulators." H. SEFTON-JONES. (American Automotoneer Co., U.S.) January 6th.
528. "Circuit arrangements for connecting a trunk line telephone exchange with the subscribers of a local automatic exchange." SIEMENS BROS. & Co., LTD. (Siemens & Halske Akt.-Ges., Germany.) January 6th. (Complete.)
535. "Terminals such as contacts and electrodes in electrical apparatus." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) January 6th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1911.

SYSTEMS OF ELECTRICALLY TRANSMITTING POWER TO THE SCREW SHAFT OF VESSELS. Allmanna Svenska Elektriska Aktiebolaget. 19,903. September 7th. (December 9th, 1910.)

REGULATOR FOR DYNAMO-ELECTRIC MACHINES. T. Ferguson. 20,586. September 18th. (September 17th, 1910.)

TROLLEY COLLECTORS FOR ELECTRIC TRACTION SYSTEMS. N. Peffer. 22,295. October 10th. (October 24th, 1910.)

ELECTRIC REGULATORS. H. Leitner. 81. January 2nd.

ARMATURES FOR MAGNETO-ELECTRIC GENERATORS. Albion Motor-Car Co. and R. B. Murray. 198. January 4th.

CONTROL OF ELECTRICALLY-DRIVEN PRINTING PRESSES AND THE LIKE. British Thomson-Houston Co. (Allgemeine Elektricitäts Ges.) 5,186. March 1st.

ELECTRIC MOTOR CONTROL SYSTEMS. British Thomson-Houston Co. (General Electric Co.) 5,998. March 9th.